

THE PROFITABILITY OF VARIOUS WHEAT
PASTURE MANAGEMENT PRACTICES

By

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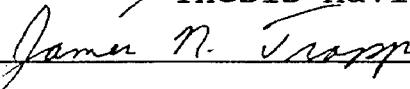
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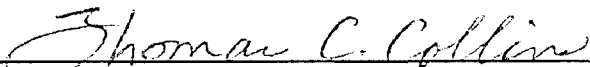
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CHAPTER I

INTRODUCTION

The utilization of winter wheat for the production of both grain and livestock is a common practice in Oklahoma. By grazing wheat forage produced during the early phases of wheat growth, producers may receive additional revenue with little or no adverse effects on wheat grain production. Wheat grazing provides producers in Oklahoma, and portions of other Southern Plains states, income opportunities that other wheat producers are not as fortunate to have. Studies have indicated that 30 to 70 percent of Oklahoma's wheat acreage is grazed, with the majority of the state's wheat producing areas having grazing rates in excess of 50 percent (Harwell, 1974). It has been estimated that about 1.5 million stocker cattle are grazed in years when there is favorable weather for wheat growth (Tweeten, 1982).

The importance of cattle and winter wheat to Oklahoma's economy are significant. Over the past two decades, grazing stocker cattle on wheat pasture has been the most profitable cattle production enterprise available to Oklahoma stockmen (Bernardo and Wang, 1991). In 1991, cattle and calves had a value of production of approximately \$1.5 billion, while winter wheat had a value of production of \$399 million. In

1991, there were 7.4 million acres of wheat planted and 5 million acres harvested. Together these two commodities combined for over 66 percent of the total value of all agricultural products for the state (Oklahoma Agricultural Statistics, 1991). Nationally, Oklahoma is a leading producer of both stocker cattle and wheat. Currently, Oklahoma ranks second behind Texas in total stocker cattle production. In winter wheat production, Oklahoma is ranked third following only Kansas and North Dakota (Stat. Abs. of the U.S., 1991).

Figure 1.1 provides some insight on the economic circumstances facing wheat. A 25-year series of returns to land and management for a representative wheat stocker cattle enterprise is presented. The net returns were estimated using historical livestock prices and input costs and assume a constant level of gain and input use over time. Fall-winter grazing was assumed to occur for 135 days and gains over the period averaged 1.8 pounds per day. Similar net return distributions were estimated for nine other Oklahoma cattle enterprises which include 5 cow-calf enterprises, wheat graze-out, summer-long stocking, intensive early stocking and winter roughed stockers (see Bernardo and Wang, 1991). The fall-winter grazing wheat stocker enterprise was identified as the most profitable enterprise of the ten cattle enterprises evaluated. Returns to land and management from the cattle enterprise only averaged approximately \$92.00 per head over the 25-year period.

In addition to the relatively high income potential from

wheat pasture grazing, several other important considerations are illustrated by Figure 1.1. First, in addition to having the highest expected net return over the period, returns from production of wheat pasture stockers were also the most variable. "This outcome primarily reflects the relatively high volatility of cattle markets during this period of the year. Also, there exists a noticeable decline in the profitability of the enterprise over the 25-year period. This result may be attributed to increased real costs of production as well as continued development of the wheat stocker industry" (Bernardo and Wang, 1991). That is, as the industry has developed, increased competition for calves has resulted in a shrinking of potential profits.

High levels of risk and shrinking profit potential combine to present an increasing managerial challenge to wheat-stocker producers. Many of the variables which affect the profitability of wheat pasture grazing cannot be controlled. Producers have little or no control over such factors as weather, cattle prices, wheat prices, government farm programs, or the price of inputs. They can, however, structure their operations to take advantage of available resources and market conditions. Because most producers are subjected to the same market and environmental conditions, often times the difference between success and failure are these managerial responses on the part of the producer.

In order to increase the probability of profit, many different managerial programs have been utilized. These

practices have primarily been based upon tradition and simple economic principles. Many current practices need to be validated, and their economic significance evaluated.

In order to examine a number of these practices the traditional thesis format will not be followed. This thesis will consist of four independent chapters each addressing one aspect of the wheat pasture grazing enterprise. Introductory and summary chapters will also be included.

Description of Wheat Pasture System

The development of a wheat pasture production system is a constant and ongoing process. Producers decisions and activities prior to the growing and grazing season play key roles in the success or failure of the system. The coordination of two distinct enterprises into one system requires prior planning and preparation. All component parts must fit together in order for the program to be successful.

A wheat pasture system is made up of wheat production and livestock production. Table 1.1 presents a general outline of key production variables and decision points, and the approximate times these activities are performed. Wheat production is a year-round process. However, if cattle are to be grazed, several managerial practices regarding wheat must be adjusted in order to maximize the probability that adequate forage is available. This description is not intended to include all production activities, but is an attempt to describe some of the important considerations in a typical

production year.

During the summer months of June and July, producers primarily concentrate on summer tillage practices to eliminate stubble and start preparing for next years' crop. Utilizing tillage practices which minimize soil moisture losses is critical. Variety selection and soil testing are also important considerations during these summer months.

Soil fertility management is a key planning variable for forage growth. Fertilization trials have produced mixed results as to the magnitude of benefits, but all substantiate the importance of proper fertilization. Oklahoma Cooperative Extension agronomists recommend nitrogen and phosphorous applications be based upon a yield goal and soil test. A current rule-of-thumb is that 60 lb N/acre is required for each ton of forage produced.

Planting date decisions are often influenced by factors out of the producers' control. Wheat for forage can be planted as early as mid-August and as late as December. However, for maximum fall and early winter forage, a late-August planting date is recommended. For each two week delay in emergence during August and September, potential forage production may be reduced by 1,000 pounds per acre (Krenzer, et al.). Utilizing a wheat pasture system requires that sowing date be at least two to three weeks earlier than for production of grain only (Johnston, et al.). Nonetheless, producers must be prepared for potential problems that may arise as a result of this earlier seeding date. Soil moisture

is often a significant problem of early seeding, as well as increased weed and insect populations.

Stockers are typically purchased in late August through September and purchase decisions are based upon perceived forage availability (Walker et al., 1988). Oklahoma producers prefer cattle weighing approximately 400-425 pounds that are English or English crosses (Walker et al., 1988). Before they are placed on pasture, cattle are typically placed in a receiving program which lasts from 2 to 30 days.

Stocker placement date is dependent upon available forage. Typically, stockers are placed on pasture in late-October or early-November. Donnelly and McMurphy recommend that first grazing take place when 8-10 inches of top growth is present and sufficient root development has taken place. Grazing should not take place until wheat has developed a secondary root system (Krenzer).

Length of the grazing season also varies with forage availability and the onset of jointing in the plants. Fall-winter grazing in normal years will last from 85 to 135 days. Stocker cattle are typically stocked at densities ranging between 2 and 3 acres/head during fall and winter grazing, and at an average density of 0.5 acres/head during spring grazing (Walker et al., 1988). Average daily gain ranges from 1.5 to 2.0 pounds per day during fall and winter, and jumps to approximately 2.25 to 2.75 pounds per day in the spring. The most common practice is to use a continuous grazing system; however, some producers utilize rotational and limit grazing

programs.

Grazing past jointing has been shown to significantly decrease grain yields (Dunphy et al., 1982). Many factors affect jointing in wheat plants, and producers must be aware of jointing date so that grain yields are not reduced. Jointing usually occurs in Oklahoma between March 5 and March 20 (Krenzer). Producers who wish to harvest grain, remove cattle in late February or early March. Typically, cattle are consolidated on a portion of the total wheat pasture designated for graze-out. If a calendar date system is used, removal dates must be early enough so that grain yields will not be reduced, even in early jointing years. Producers will remove cattle on graze-out acreage when forage is no longer available, typically in May or June.

Changes in government program provisions have caused many producers to alter their operations. The introduction of the 1990 Farm bill required producers to use 15% of their crop acreage base (CAB) as Normal Flex Acres. These acres are not eligible for deficiency payments whether they are planted to the program crop or "flexed" to another crop. Optional flex acres can also be used. If optional flex acres are planted to the program crop it is eligible for deficiency payment. If this acreage is "flexed" to another crop it is not eligible for deficiency payment. (A more detailed description of government program provisions is included in Chapter II). The set-aside acres necessary for program compliance often offer producers opportunities to either graze-out stockers or

produce a hay crop. If hay production is desired, it will usually take place in the month of May and must be done before June 1, when the crop must be destroyed. Variety differences and climatic conditions will determine the exact dates.

Wheat harvest typically occurs in June across the state of Oklahoma. Wheat fields usually ripen from the southern part of the state to the north. Typical dryland grain yields range from 25-40 bushels/acre.

Producers constantly address many other managerial concerns not mentioned above. Insect and weed management programs are year-round processes for wheat farmers. Livestock management practices can differ greatly from those described above. Stocker cattle have been used to describe the system, however, a number of alternative livestock enterprises can utilize wheat pasture. Any type of ruminant animal (horse, sheep, goats, etc.) can utilize wheat forage. Cow-calf producers utilize wheat pasture to a large degree to decrease winter feeding costs. Calves from spring calving cow herds can be retained and grazed following weaning.

A substantial portion of the wheat that is grazed in Oklahoma is leased. Lease arrangements are useful for producers with limited finances or those who wish to decrease their risk levels. Most wheat pasture leases fall under one of three categories: \$/cwt/month, \$/pound of gain, or \$/acre. The \$/cwt/month option appears to be the most prevalent option in the state. The average price of each option fluctuates somewhat from year to year, reflecting current forage supply

and demand conditions of the region.

Previous Research

The wheat pasture system offers producers many alternatives and opportunities. The economic significance and prevalence of the practice would seem to justify the need for research attention. However, research in this field has been limited. Managerial practices currently employed by producers are often based more on tradition and habit than on production research and economic principles. The majority of past research available to managers is primarily production based, and usually concerned with only one of the enterprises. Only limited research has addressed the complex interactions between the two enterprises. Economic analyses of wheat pasture systems are particularly scant over the last couple of decades.

A summary of research efforts prior to 1983 is provided in the *Proceedings of the National Wheat Pasture Symposium*. The symposium addresses research projects conducted to address several agronomic, livestock, and economic aspects of the wheat pasture system. The symposium also addressed future trends and the anticipated affect of government programs on decision making processes concerning the use of pasture.

Bernardo and Wang (1991) evaluated real returns from beef production enterprises in Oklahoma. Both cow-calf and stocker cattle enterprises were evaluated over ten and twenty-five year periods. They found that both fall/winter and spring

wheat pasture stockers were the most profitable cattle enterprises available to Oklahoma producers. They also noted that real returns decreased over the evaluation period, due primarily to an increase in the real cost of production. Because production costs will undoubtedly continue to increase, more research will be required to maintain the relatively high income potential from the enterprise.

Rodriguez et al., (1990) developed a Wheat Grazing Systems model for the U.S. Southern Plains for economic analysis of grazing management decisions under weather uncertainty. The model combined the CERES-Wheat growth simulation model with a stocker intake-growth model to represent the wheat-stocker production system. Risk associated with stocking density, beginning and termination date was investigated when weather was varied. Optimal stocking densities were shown to be sensitive to producers' risk preferences. The development of this model will be useful for evaluation of a number of other economic questions pertaining to wheat pasture grazing.

Honeycutt (1988) used the Wheat Grazing Systems model to determine the optimal level of supplemental forage stocks with which to start the winter grazing season given alternative stocking rates, weather uncertainty, and seasonal variations in hay prices. Lower stocking densities produced average net revenues which were lower in variability, and reduced the importance of producers' decisions regarding the quantity of forage stocks to maintain. Higher stocking densities

increased average net returns but increased variability. Decisions concerning forage stocks prior to the season become much more important under these strategies.

Research projects in the production sciences have addressed a variety of topics in the wheat pasture area. Most of this research addresses either the livestock or wheat component of the production system, but does little to explain the complex interactions between the two enterprises.

Anderson and Horn (1987) found that the potential use of high protein by-product feeds in supplementing growing cattle on wheat pasture is particularly useful because of the rapid rate of ruminal degradation of wheat forage and the relative low pH values of wheat pasture cattle. These authors also found that monensin and lasalocid increase daily gains of growing cattle on wheat pasture, and greatly improve the economics of wheat pasture supplementation programs.

The relationship between forage availability and consumption has not yet been definitely determined for wheat. Limited experimental data suggests that 750 grams of dry matter per kilogram of liveweight is the level of forage availability where voluntary intake begins to decline. On annual ryegrass, seventy-four percent of the variation in intake of cattle was accounted for by the digestible organic matter content and the amount of forage available for grazing (Telford and Ellis, 1981). Caldwell(1984) found that forage regrowth following grazing is positively related to the amount of leaf material remaining on the plant.

Limited research has been conducted under irrigated conditions in the Texas Panhandle, evaluating the impact of grazing on wheat production. Winter and Thompson (1987) showed that grazing prior to jointing reduced grain yields marginally, while grazing past jointing seriously affected yields. Christiansen et al., (1989) reported on the changes between grain yields and grazing caused by climate and grazing practices. The authors also noted some positive interactions between grazing and seasonal forage production.

Krenzer(1988) and Smith et al.(1987) showed the considerable difference in grain yield potential exists in commercially available wheat varieties in Oklahoma. For evaluation purposes, the practical alternative to grazing is forage clipping to estimate forage production. Varieties can be evaluated on the combination of forage and grain production (Krenzer and Doye, 1988).

Stocking density and forage production capabilities have been evaluated by Krenzer et al.(1988) and Howle et al.(1984). They found that wheat varieties differ in their forage producing capabilities, and these differences could directly translate into differences in beef production potential. Stocking rate plays a major role in determining animal production from grazed forages (Hart, 1972). Bransby et al. (1988) found that forage variety and stocking rate often interact so that the relative advantage of one variety over another depends upon the stocking rate at which comparisons are made.

While some production and economic research in the area of wheat pasture grazing is available, much of this research is contradictory and doesn't consider all dimensions of the production system. Research which addresses all components of the system and answers questions not yet addressed will be of benefit to the industry. Additional economic analysis of the wheat-stocker system must also be provided.

The Expanded Wheat Pasture Research Program conducted at Marshall, Oklahoma, by the Animal Science, Agronomy, and Agricultural Economics Departments of Oklahoma State University is designed to expand upon current knowledge, attempt to fill in part of the unknown areas, and answer questions on current topics of importance to producers. By improving both the physical and economic stability of the wheat pasture/stocker enterprise, it is hoped that producers can more effectively take advantage of this unique opportunity.

Specific areas to be addressed by the Expanded Wheat Pasture Research program include the development of supplemental feeding strategies and their effect on intake, stocking density, and cattle performance. Agronomic practices evaluated include wheat planting date, effect of cattle grazing on soil compaction, grazing termination date, variety selection, and the impact of weed control practices on forage production. In addition, the development of an economic model to evaluate the impact of the above variables with other management variables is also intended.

While not all of these issues can be addressed in this thesis, several will be evaluated. Several of the research projects currently being conducted have assimilated sufficient information to allow for economic analysis. Those topics for which adequate data is available will be evaluated.

Objectives And Procedures

Wheat/Stocker Planner

As noted above, management of the wheat-stocker production system is complex and requires a holistic approach. Decisions within each enterprise must take into account the interactions on the other enterprise. The development of a wheat/stocker management model is one of the major objectives of this study. The Wheat/Stocker Planner developed here is a computer decision aid that develops enterprise budgets for wheat and stocker cattle from user-provided inputs. Enterprise budgets are then combined to estimate whole-farm returns from the enterprise. The model also includes provisions of the farm programs available to wheat producers. Government program payments have become a significant part of their farm income and must be incorporated in planning and managerial decisions. The rules and regulations of these various programs change from year to year and producers must account for the effect of these changes on production plans. Whole-farm returns are estimated from the joint production of grain and livestock, with estimated deficiency payments

included.

The versatility of the model is one of its most desirable attributes. The economic effects of alternative managerial practices (supplementation, variety selection, etc.) can be determined, and should facilitate the economic evaluations of this study. In addition, the model should be available for extension education programs, and on-farm use in the future.

Supplementation

An economic evaluation of alternative supplemental feeding strategies will be performed using the Wheat/Stocker Planner. Three years of experimental data from the Expanded Wheat Pasture Research Program have determined that daily gain and stocking density can be increased by utilizing a supplemental feeding program. Other positive effects from utilizing one of these programs have also been determined.

The economic effects of these programs will be evaluated using an enterprise and a whole-farm approach. The whole-farm analysis will incorporate current government programs and provisions. The whole-farm approach will also incorporate the effect of increased stocking density on economic returns.

Variety Selection

A management consideration more closely related to wheat production, but having direct effects on beef production, is the variety of wheat used. If cattle are to be grazed, a variety that offers abundant forage production needs to be

utilized. Producers must also be concerned with the timing of forage growth. However, if grain harvest is desired, varieties cannot be selected based solely on their forage production characteristics.

New wheat varieties that offer improved grain and/or forage producing abilities are constantly being introduced. Producers typically use performance data when choosing the variety they will plant each year. However, when expressed in physical terms, this performance data is useful only when the wheat will be used for one enterprise or the other. For producers who want to graze and harvest grain, the combined grain yield and forage production characteristics must be converted to a single profitability index.

A more comprehensive procedure is needed to evaluate current and future varieties on their profit potential, and determine how all aspects of a grazing system interact. The effects of price changes in wheat and livestock industries on the net return levels of different varieties also needs to be determined.

Wheat Jointing Date

Grazing wheat past the jointing stage has been shown to decrease wheat yields (Winter and Thompson, 1989). The degree to which yields are reduced depends on a number of factors (e.g. climate, variety, grazing pressure). The economic losses caused by extended grazing past jointing can be very substantial. The ability to accurately recognize jointing in

wheat plants and remove cattle at that time should allow producers improved net returns. Returns can be maximized in that cattle can be grazed right up to jointing date and removed before grain yields are reduced.

Many producers utilize a calendar date system when removing cattle from wheat pasture in the spring. A calendar removal system can be employed if cattle are removed early enough that grain yields are not diminished even in early jointing years. However, utilization of a calendar removal system will likely result in lower net return levels.

A study will be conducted to determine the value of using jointing date information in determining grazing termination date. Economic returns from calendar date strategies will be compared to jointing date strategies. Stochastic dominance procedures will be used to determine the lower and upper bounds on the value of jointing information given varying producer risk preference intervals.

Organization Of Thesis

This thesis will not follow a traditional thesis format (introduction, objective statement, literature review, methodology description, results, and summary). This thesis will consist of four independent chapters each focusing on a separate management practice or issues in the wheat pasture/grazing area. An introductory and summary chapter are also included. This chapter provided an introduction and brief summary of past research and several of the major

problems and issues currently facing the industry. Chapter II describes the Wheat/Stocker Planner and addresses the importance of the government farm program provisions to wheat-stocker producers. Chapter III addresses the economic feasibility of wheat pasture supplementation programs. Chapter IV estimates and ranks different wheat varieties based upon their grain and forage production levels and economic returns, under three alternative forage allocation methods. Chapter V examines grazing termination dates and determines the value of wheat jointing date information to wheat-stocker producers. Finally, chapter VI provides a brief summary of the results. The need for further research is discussed, as well as the importance and implications of this current research.

TABLE 1.1
CALENDAR OF LIVESTOCK AND WHEAT
PRODUCTION ACTIVITIES

ACTIVITY	APPROXIMATE DATE
Summer Tillage	June-July
Variety Selection	June-July
Soil Test	July
Pre-planting Activities (Tillage, fertilization, etc.)	August-October
Purchase Stockers Receiving program	August-October 2-30 Days
Sowing Date	
Grain and Forage	August-September
Grain Only	October
Placement of Stockers on Pasture	October-November
Spring Fertilization (Topdressing)	February
Fall/Winter Removal Date	February-March
Hay Harvest (if necessary)	May
Graze-out Removal Date	May-June
Harvest Date	June

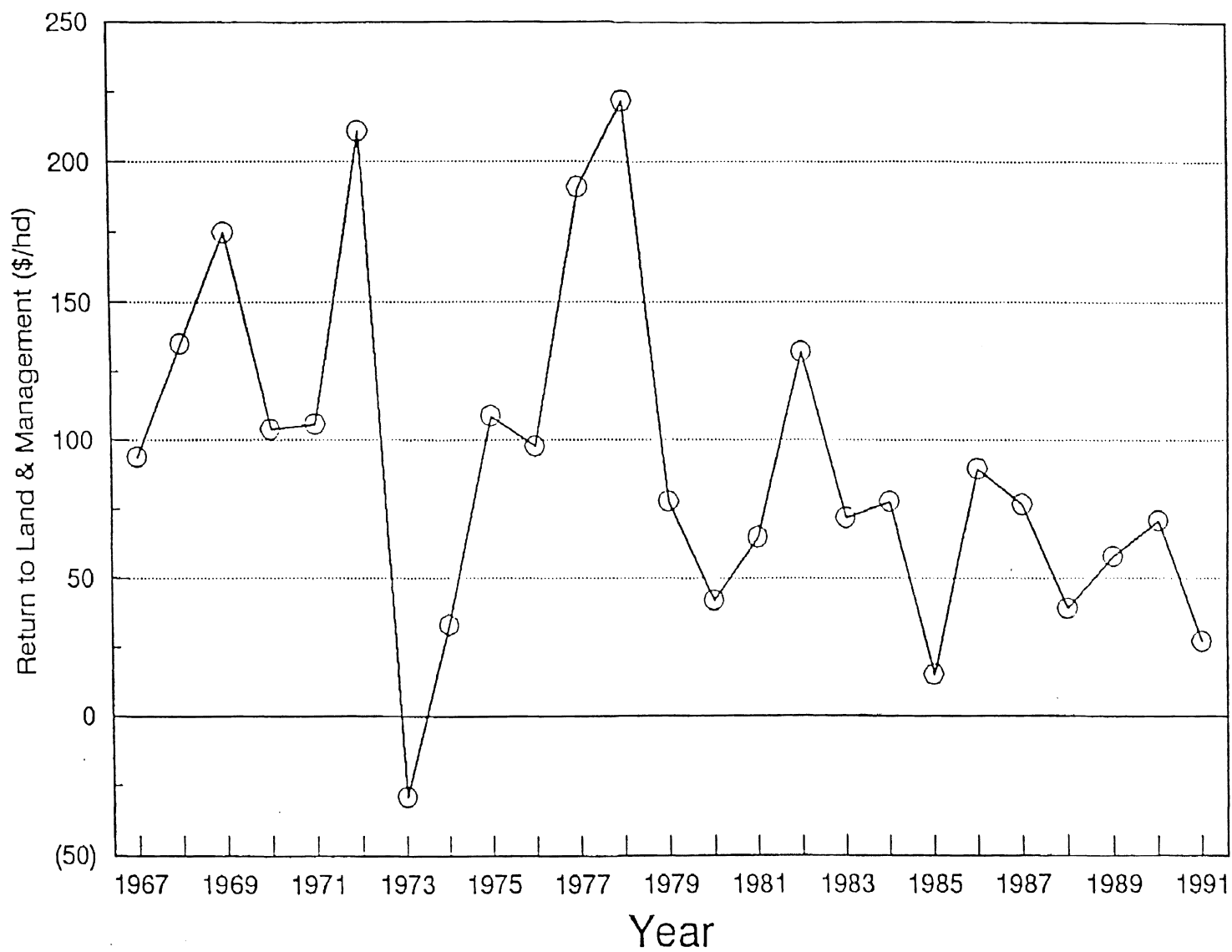


Figure 1.1. Returns to Land and Management for Wheat Stocker Enterprise

CHAPTER II

WHEAT/STOCKER PLANNER

Management of the wheat-stocker production system is complex and requires that producers take into account the interactions between the two enterprises. If cattle are to be grazed, decisions concerning one enterprise will have direct and possibly lasting effects on the other enterprise. Wheat variety and cultural practice decisions affect forage production and availability, which in turn, determine the number and extent of grazing by livestock (i.e. number, weight, stocking density, placement and pull-off date, etc.). Decisions made with respect to the stocker cattle will also influence grain production and yields. In a wheat grazing system it is difficult, and managerially unsound, to separate the two enterprises. Decision making must be conducted in a holistic framework, where the impact of decisions on the entire production system must be considered.

Whole-farm planning considers the relative value of each of the separate enterprises and combines them in a manner consistent with the goals set forth by the manager. It includes a means of projecting the more quantifiable aspects of alternative production, marketing, and financial plans, including the amount of land, and capital required, and the

income expected. Completing the planning process also provides an opportunity for the manager to more thoroughly evaluate the less quantifiable aspects, including the management requirements, working conditions, and the stress related to high-risk and large debt levels (Boehlje and Eidman).

Not only must producers understand the wheat and livestock industries and the complex interactions that are involved in a grazing system, they must also concern themselves with the policies and provisions of the government wheat programs. Government programs play a key role in planning and implementing any type of farming/ranching enterprises. Farmers face several options concerning how they wish to participate in the commodity program. Once an option is selected, several other decisions must also be made which will impact program payments. In today's agricultural economy, the government program payments are becoming as important to firm profitability as wheat and stocker prices and/or productivity.

A managerial tool which can evaluate the complete wheat-stocker production system (wheat, livestock, and government programs) is needed so that actual and alternative production practices can be evaluated and the economic ramifications of these practices determined prior to the production season. By incorporating these separate but related enterprises into a single analysis, it is possible to evaluate the system as a whole and not just the component parts.

The Wheat/Stocker Planner was designed to conduct this type of multiple-enterprise analysis. The Planner is a microcomputer decision aid developed to assist producers in evaluating wheat and stocker cattle production alternatives. The current version of the model consists of a Lotus 1-2-3 spreadsheet designed to estimate net return from wheat/stocker production based upon user-provided input. Information extracted from these spreadsheets can be used by the manager to evaluate production plans prior to the production year or assess alternatives at various decision points throughout the year.

The Wheat/Stocker Planner was developed for PC microcomputers using MS-DOS version 2.0 or higher in combination with Lotus 1-2-3 version 2.1 or higher. Experience in using microcomputers and Lotus 1-2-3 will facilitate the successful use of the Wheat/Stocker Planner. However, individuals possessing a basic knowledge of Lotus should be able to successfully run the program.

Description Of The Model

The process for completing an analysis using the model and an explanation of the proper procedure for entering the required data is included. The model is divided into four principal sections. The first three sections are used to organize production and economic information into enterprise budgets. Enterprise budgets for stocker cattle are on a per head basis, while the wheat budget is on an acre basis. The

fourth section combines the enterprise data into a whole-farm analysis.

The model is macro driven for ease and convenience. Movement between budgets and input screens, conducting sensitivity analysis, and printing of budgets can be done simply and easily with the macro commands listed on the opening screen. By simultaneously pressing the ALT key and the appropriate letter, the desired screen can be accessed. The menu of ALT commands is given below:

- Alt-A - Fall/winter stocker budget input.
- Alt-B - Fall/winter stocker enterprise budget.
- Alt-C - Graze-out stocker budget input.
- Alt-D - Graze-out stocker enterprise budget.
- Alt-E - Wheat budget input.
- Alt-F - Wheat enterprise budget.
- Alt-G - Whole-farm and government program input.
- Alt-H - Estimated net returns from wheat/stocker production.
- Alt-I - Conduct sensitivity analysis.
- Alt-P - Print budgets and net return information.

The analysis is initiated by completing a series of input screens; enterprise budgets are then developed for the three principle enterprises making up the wheat/stocker production system -- fall/winter stockers, graze-out stockers, and winter wheat. The whole-farm input screen is then completed, where information concerning the total wheat acreage, number of stockers purchased, and selected government program information is entered. Based upon the whole-farm information, government program input and enterprise budget information, total net returns from wheat and stocker production are estimated. Net returns are estimated under

both the "regular" and "0/92" wheat commodity program provisions, as well as a "no participation" alternative.

Using the whole-farm and enterprise information, the user may also conduct a sensitivity analysis of projected net returns. Net return estimates may be calculated for alternative levels of selected price and yield variables, using either of the farm programs or the "no participation" option. Such information is useful to managers in assessing the income risk inherent in the proposed farm plan, and is much faster and more convenient than replicating the analysis for each price or production change.

To illustrate the use of the model, a representative production situation was developed. The representative operation consists of 1,200 acres of wheat with only 1,000 of these acres classified as ASCS base acres. The unit is stocked with 500 head of 425 pound steers which were purchased in November and will be sold in May, after wheat has been grazed-out. Required set-aside and flex acres will be utilized to graze-out as many steers as possible. The remaining wheat will be harvested and the grain will be sold. Inputs used in this example follow each data description and are reported in square brackets. Example input screens have been included for each section.

Stocker Input: Fall/Winter Grazing

Information required to complete the fall/winter stocker enterprise budget is entered into the fall/winter stocker

input screen (ALT-A). Following insertion of all requested information, the completed enterprise budget is generated by pressing F9.

Two input screens must be completed. The first section requests information about the cattle purchased and several management considerations. The next screen consists of supplemental feed and labor use information. Table 2.1 shows the input screen for this section. All cells require input, and cell addresses are in parenthesis to the right of the subject heading.

Performance Data

Purchase Weight (J4)

Average weight (in pounds) of calves purchased [425].

Length of Receiving Program (J5)

Number of days cattle are held prior to being placed on pasture [10].

ADG During Receiving (J6)

Expected average daily gain (pounds/day) during the receiving program [1.0].

Days Pastured (J7)

The projected length of the fall/winter grazing season (number of days) [115].

ADG on Pasture (J8)

Expected average daily gain (pounds/day) during the all/winter grazing period [2.10].

Death Loss (J9)

The projected death loss (expressed as a percentage) occurring during the fall/winter grazing period [0.02].

Stocking Density (J10)

The stocking density (acres/head) during the fall/winter grazing period [2.00].

Economic Data

Calf Cost (M4)

The cost of the purchased calf (\$/pound) [.93].

Expected Selling Price (M5)

The expected price received (\$/pound) when sold [.80].

Interest Rate (M6)

The interest rate that is paid on the calves and on other operating inputs. Interest rates will be charged on calves over the entire period of ownership [.10].

Veterinary and Medical Expense (M7)

Average veterinary and medical expenses expressed on a \$/head basis. A prorated sick pen expense may also want to be added. [8.00].

Marketing Charge (M8)

The commission charged when the animals are sold (\$/cwt). It is only charged when they are sold [1.72].

Hauling (M9)

Hauling expense expressed on a \$/cwt basis. Freight is based on sale weight of calves [.35].

Machinery & Equipment (M10)

Machinery and equipment cost on a \$/head basis [6.09].

Beef Checkoff (M11)

Beef checkoff expense if it is incurred [0.00].

Miscellaneous Expense (M12)

Any expense that is not included in any of the above cells can be entered here on a \$/head basis [0.00].

Labor Cost (M13)

The amount paid to hired labor or the value of the operators labor (\$/hour) [5.00].

Revenue Option: (J15)

The revenue option increases the flexibility of the model. Lease terms and payment practices are unique for grazing, and will vary substantially across regions. Realizing that there are many different ways that wheat pasture agreements are developed, three different options have been included. This will not only improve decision making, but may also be used to determine whether it would be more profitable to own stockers or take them in on a pound-of-gain basis. If the cattle are owned a "0" is entered into cell (J15). A "1" is entered if revenue is determined on a pound of gain basis. By entering "2", revenue is calculated based on \$/cwt/month. The monetary value associated with each revenue option is entered into cell (J17) or (J18) depending upon the option used.

Pasture Lease: (M15)

The pasture lease option allows for flexibility in calculating pasture costs. A large portion of the wheat that is grazed is leased. It is possible to evaluate a wheat/stocker enterprise with a \$/cwt/month, a \$/pound of gain, or a \$/acre option. This option permits the user to evaluate several different alternatives related to leasing

pasture. The pasture lease option is entered in a manner similar to the revenue option. A "0" is entered into cell (M15) if the land is owned or no land costs are to be assessed. A 1, 2, or 3 is entered to estimate land costs on a \$/acre, \$/cwt/month, or a \$/pound of gain basis, respectively. The cost associated with each revenue option will be entered into cells (M17), (M18), or (M19).

Feed

Supplemental Hay (J23, K23, L23)

The number of days fed, pounds fed each day, and the price (\$/lb) [20] [10] [.03].

Supplemental Feed (J24, K24, L24)

The number of days fed, pounds fed each day, and the price (\$/lb). [0] [0] [0]

Salt/Mineral (J25, K25, L25)

Number of days fed, pounds fed each day, and the price (\$/lb) [115] [.25] [.15].

Labor

Receiving (J28, K29)

The number of hours/head/day and number of days spent during the receiving phase [.05] [10].

Feed/Check (J29, K29)

The hours/head/day and number of days spent feeding and checking on the animals [.07] [11].

Miscellaneous (J30, K30)

Any labor cost that is not included in either receiving or feed/check [0] [0].

Fall/Winter Stocker Budget

When all information has been entered, an enterprise budget will be generated by pressing the F9 key, and viewed by pressing ALT-B. The budget summarizes the projected receipts and costs from the fall/winter stocker enterprise on a per-head basis. The fall/winter stocker budget generated from the representative production situation is shown in Table 2.2. Steers gained 238 pounds/head over the 115 day grazing season, after death losses were considered, and sold for \$80.00/cwt. Total operating costs were \$451.52, with calf purchase price providing the majority of the expense. Interest expense was the largest non-cattle expense followed by marketing, veterinary and medical expenses, and labor. Returns above operating costs equalled \$78.95 per head.

For owned cattle, revenues are calculated as the product of the sale price and ending weight, which factors in death loss. Revenues calculated on a pound-of-gain basis are calculated based upon weight gain during the receiving and grazing periods. Revenues calculated on a \$/cwt/month basis are computed based upon the initial weight and total number of months cattle are held.

Feed costs are calculated as the product of pounds fed (days fed * lbs/head/day) and feed price. Labor is calculated as the product of "hours/head/day" and "days" entered in the labor input section. The total labor requirement reflects the sum of all three components: receiving, feeding, and

miscellaneous labor. Freight and marketing charges are based on the average sale weight. Interest on operating capital is calculated using the interest factor approach (Boehlje and Eidman). Interest is charged on all input costs except freight, marketing costs, and pasture lease.

Stocker Input: Spring - Graze-Out

The graze-out stocker input screen is an abbreviation of the fall/winter stocker input screen. Table 2.3 provides an illustration of this input screen. Most stocker production costs are captured in the fall/winter budget. Thus, only additional costs are entered into this section. Most of the entries are entered exactly as the fall/winter stocker budget. The stocking density that is entered will be multiplied by the number of graze-out acres to determine the number of head to be grazed-out.

Performance Information

Days on Pasture (P4)

The number of days cattle are to be grazed during the graze-out period [65].

Expected ADG (P5)

Expected average daily gain (pounds/day) during the graze-out period [2.50].

Death Loss (P6)

Projected death loss (expressed as a percentage) occurring during the graze-out period [0.02].

Stocking Density (P7)

The stocking density during the graze-out period (acres/head) [0.5].

Economic Data

Selling Price (S4)

The expected selling price (\$/pound) of the cattle at the conclusion of the graze-out period [.72].

Veterinary and Medical Expense (S5)

Any additional vet or medical charges that are incurred through the graze-out period. This might include re-implanting and worming, tags, etc. [3.00].

Machinery & Equipment (S6)

Any additional machinery and equipment charges that are incurred. These charges are on a \$/head basis [2.45].

Miscellaneous Expenses (S7)

Any additional cost that was not captured above on a \$/head basis [0.00].

Feed

Supplemental Hay (P11, Q11)

The number of days fed and pounds/day. Price is determined in the fall/winter budget [0] [0].

Supplemental Feed (P12, Q12)

The number of days fed and pounds/day. Price is determined in the fall/winter budget [0] [0].

Salt/Mineral (P13, Q13)

The number of days fed and pounds/day. Price is determined in the fall/winter budget [0] [0].

Labor

Feed/Check (P16, Q16)

The hours/head spent feeding and checking during the graze-out period [.07] [10].

Miscellaneous (P17, Q17)

Any additional labor that is required during the graze-out period [0] [0].

Graze-Out Stocker Budget

When all of the graze-out stocker data have been entered, an enterprise budget will again be calculated by pressing the F9 key, and can be viewed by pressing ALT-D. The graze-out stocker budget will reflect costs and returns for stockers held over the entire fall/winter and graze-out period. The additional costs from graze out will be added to the cost from the fall/winter budget. This approach provides more information about the total cost required to take stocker cattle through the graze-out period. Revenues and costs attributable to the graze-out period are reported at the bottom of the budget. Revenue and costs calculation procedures are identical to the fall/winter budget.

The graze-out stocker budget for the representative situation is included as Table 2.4. Average steer selling weight is 822 pounds and selling price is \$72/cwt. Each steer returns \$118.91 above operating costs. Holding cattle through the graze-out season is profitable; additional revenues are \$61.62 per head while expenses only increase \$21.67 per head.

Wheat Input

The wheat budget input screen requires price and performance information of the wheat enterprise to be entered. All relevant information concerning wheat is input and budgets are developed. Table 2.5 shows the wheat input screen.

Input Quantities

Seed (X4)

The quantity of seed used in bushel/acre [1.5].

Nitrogen (X5)

Pounds of nitrogen fertilizer applied per acre [50].

Phosphorous (X6)

Pounds of phosphorous fertilizer applied per acre [25].

Other Nutrients (X7)

Pounds of any other type of nutrient applied per acre [10].

Herbicide (X8)

The number of applications of herbicide [1].

Insecticide (X9)

The number of applications of insecticide [1].

Price and Yield

Expected Yield (X12)

Projected grain yield (bushels/acre) [32].

Expected Price (X13)

The expected price of wheat when it is sold [3.00].

Costs Not Incurred on Graze-Out Acres (X16)

Costs (e.g., harvest, hauling, etc.) that will not be incurred on acres grazed out. This cost will be deducted from total operating cost to determine costs associated with graze-out acres [30.00].

Input PricesSeed (AA4)

The cost of seed in \$/bushel [7.50].

Nitrogen (AA5)

The cost of nitrogen fertilizer in \$/pound [.20].

Phosphorous (AA6)

The cost of phosphorous fertilizer in \$/pound [.10].

Other Nutrient (AA7)

The cost of any other nutrient applied as \$/pound [.15].

Herbicide (AA8)

The cost of an herbicide application to one acre [3.00].

Insecticide (AA9)

The cost of an insecticide application to one acre [4.00].

Custom Harvest (AA10)

The cost (\$/acre) of custom harvesting [12.00].

Custom Harvest (AA11)

Any additional harvest cost assessed on a per-bushel basis [0].

Custom Hauling (AA12)

The cost of custom hauling (\$/bushel) [.10].

Interest Rate (AA13)

The interest rate on the operating loan used to pay for inputs. Enter as a percentage [.13].

Miscellaneous (AA14)

Any miscellaneous costs that are not captured elsewhere.
Enter as \$/acre [0.00].

Labor Rate (AA15)

The cost of labor per hour [5.00].

Machinery and Labor Costs

It is possible to either enter in machinery and equipment cost per acre directly, if these are known, or have the program calculate these cost. If the costs are known, "NO" is entered into cell (Z17) and the per-acre cost are as follows:

Machinery cost (X20)

Total machinery and equipment cost (\$/acre) [0.00].

Labor (AA20)

The amount of labor each acre requires (hours/acre)
[0.00].

If these cost are not known, per-acre costs can be estimated based upon information concerning operating costs of individual power units and implements. In this case, "YES" is entered into cell (Z17) and the required information is entered in the following two input screens.

Power Unit

First, the types of power units used in the wheat enterprise are entered. Next, the cost per hour of operating each machine is entered. For example:

<u>Power Units</u>	<u>Costs (\$/hour)</u>
1. 110 HP Tractor	7.13
2. 135 Hp Tractor	8.39
3.	
4.	

Implements

All implement equipment used in the wheat enterprise and their cost per hour are then entered. For example:

<u>Implements</u>	<u>Costs (\$/hour)</u>
1. Disc	2.69
2. Chisel	2.53
3. Springtooth	1.07
4. Drill	3.98
5. Fertilizer Spreader	3.00

Schedule of Operations

The type of operation that will be performed (e.g. sowing), the power unit which will be used (e.g. 135 HP Tractor=2) and the implement used to accomplish this task (e.g. Drill=4), and the number of acres that can be completed in one hour (e.g., 6 acres/hour) is entered in this section. Per-acre operating costs and labor requirements are estimated based upon the information provided. For example:

<u>Power Operation</u>	<u>Cost Unit</u>	<u>Labor Implement</u>	<u>Acres/hr</u>	<u>(\$/ac)</u>	<u>(hr/ac)</u>
1.Chisel	2	2	6.25	1.75	0.19
2.Disc	2	1	6.67	1.66	0.18
3.Springtooth	2	3	10.0	0.95	0.12
4.					
5.					
6.					

Wheat Budget

As with the other input screens, an enterprise budget

will be generated from these inputs by pressing the F9 key, and can be viewed by pressing ALT-F. Machinery variable costs are the sum of the per-acre costs of each operation included in the schedule of operations. The costs of each operation is calculated as the cost per hour of operating the power unit and implement multiplied by the acres covered in one hour. The labor requirement (hours/acre) is assumed to be 20 percent above the machinery hours required per acre. This factor takes into account labor time required to fuel, lube, and move machinery to the field. Returns above operating cost and the short-run break-even price and yield are also calculated.

A sample wheat enterprise budget is shown in Table 2.6. Total receipts are \$96.00 per acre; wheat yields average 32 bushels per-acre at a price of \$3.00 per bushel. Total operating costs are \$70.21 per acre which includes over \$23.00 for machinery, equipment, and harvesting expenses, plus approximately \$21.00 per acre for nutrients and chemicals. Returns above operating costs are \$25.79 per acre. The short-run break-even price and yield are \$2.19/bushel and 23.4 bushels/acre, respectively.

Whole-Farm and Government Input

The final input screen requests whole-farm information and government commodity program input (Table 2.7). Information input here will allow for the information in the enterprise budgets to be taken to the whole-farm level and allow for whole-farm calculations and analysis. The first set of values

are determined by the commodity program provisions set by USDA.

Target Price (AH3)

The target price of wheat (\$/bushel) for the year [\$4.00].

Regular Loan (AH4)

The regular loan rate (\$/bushel) for the year [\$2.58].

Emergency Loan (AH5)

The emergency loan rate (\$/bushel) [\$2.21].

Guaranteed Deficiency, "0/92" (AH6)

The guaranteed deficiency payment for producers who participate in the "0/92" program [\$1.00].

Percentage Set-Aside (AH7)

The percentage of base acres which must be taken out of production [5.00%].

These five values (cells AH3 through AH7) reflect the prices and provisions for the 1992 program year. These cells are protected, but can be changed by turning off the write protection in Lotus. The next three inputs include ASCS yield and average price situations:

ASCS Program Yield (AH9)

ASCS Program Yield for the farm [30].

5-Month Average Price (AH10)

The expected five-month average price for the period June 1992 - October 1992 [3.10].

12-Month Average Price (AH11)

The expected twelve-month average price for the period June 1992 - May 1993 [3.20].

The following four inputs specify the number of acres (or head) comprising each of the enterprises. Based upon these inputs, enterprise costs and returns are converted to whole-farm values.

Total Cropland in Grain (AH13)

The total number of acres in wheat production [1,200].

Program Base Acres (AH14)

The number of wheat base acres [1,000].

Number of Stockers (Fall/Winter) (AH15)

The number of stockers that are to be grazed during the fall/winter portion of the grazing season [500].

Number of Stockers (Graze-out) (AH16)

The number of stockers to be grazed during the graze-out portion of the grazing season. A maximum number of graze-out stockers is reported based upon the number of fall/winter stockers and death loss [490].

Policy Option

It is possible to estimate net returns under the following government program options:

- 1) Regular Program Participation
- 2) 0/92 Option
- 3) Non-Participation.

Inputs in this section determine the total number of harvested and non-harvested acres under each of the programs.

Under the "Regular Program Participation" Option, two inputs are required:

Percentage Flex Acres (AH23)

The minimum percent flex acres as set by USDA. Currently,

the minimum is 15% of base acres. Therefore, the minimum value entered is 15. Producers may opt for as many as 25% of base acres to be designated as flex acres [15].

Flex Acres Harvested (AH24)

The normal flex acres that will be harvested. This value will range between 0 and 15% of base acres [150].

Inputs for the "0/92" Option are:

Base Acres Harvested (AH30)

The number of base acres that will be harvested. The maximum number that may be harvested is 92% of base acres less set aside and flex acres. This value is calculated and shown one line below [.782].

Inputs for the "Non-Participation" Option are:

Acres Harvested (AH36)

Total number of acres to be harvested [950].

Acres Graze-Out (AH37)

Total number of acres to be grazed out [250].

Below the "Policy Options" screen a table is provided that summarizes information concerning the number of acres to be harvested, acres for graze-out, number of head of fall/winter stockers, and number of stockers held during the graze-out period. This table provides insight into how the plan is affected by each policy alternative and may be useful in determining which policy alternative is most advantageous for an individual producer. For the "Non-Participation" and "0/92" Options, acres harvested are entered above. For the "Regular Program" Option, acres harvested is the sum of deficiency payment acres and flex acres harvested. The number of head of fall/winter stockers is the minimum of the number

specified in the whole-farm input and the number calculated based upon the stocking density entered in the enterprise budget input (wheat acres/stocking density). The number of graze-out stockers is the minimum of the number of head specified in the whole-farm input and the number calculated based upon the graze-out stocking density (graze-out acres divided by stocking density). If it is not possible to graze-out all stockers that were on hand during the fall/winter period, it is assumed that they are sold after the fall/winter period with the remainder of the cattle being grazed-out.

Deficiency payment information is also summarized. The expected regular deficiency payment is calculated by subtracting the larger of the 5-month average or the loan rate from the target price. This value cannot be less than zero. The expected emergency deficiency payment is calculated as the regular loan rate minus the larger of the 12-month average price and the emergency loan rate. If this value is negative, the emergency deficiency payment is zero. Deficiency payment acres is calculated as the percentage of base acres that qualify for deficiency payments times base acres.

Net Return Summary

The Net Return Summary reports whole-farm budgets developed from information input in the stocker, wheat, and the government program sections. The following cost and return items from the enterprise budgets are used in

estimating total net returns:

total receipts, fall/winter stockers(RFS)	- (M44)
total operating costs, fall/winter stockers(CFS)	- (M60)
total receipts, graze-out stockers(RGS)	- (S24)
total operating costs, graze-out stockers(CGS)	- (S40)
total receipts, wheat(RW)	- (AA65)
total operating costs, wheat(CW)	- (AA80)
costs not incurred on graze-out acres(CGW)	- (X16)

Revenues

Deficiency Payments

Includes both the regular and emergency deficiency payment under the regular program option and the 0/92 deficiency payments under the 0/92 option. Under the "Regular Program Participation" Option, the regular and emergency deficiency payments are calculated as the product of the deficiency payment (\$/bushel), deficiency payment acres, and base yield. Under the 0/92 Option the calculation is more complicated. The deficiency payment on harvested acres is the acres harvested times base yield times the regular and emergency deficiency payments (\$/bushel). The deficiency payment on non-harvested acreage is the product of non-harvested payment acres, program yield, and the larger of the guaranteed deficiency and the regular deficiency payment.

Wheat

Wheat revenue is calculated as the product of per-acre wheat receipts (RW) and the number of acres harvested.

Fall/winter stocker

Revenue reflects gross receipts earned during the fall/winter grazing period and is calculated as per-head revenue from fall/winter grazing (RFS) times the number of fall/winter stockers.

Graze-out stocker

Reflects the additional revenue earned during the graze-out period and is calculated as per-head graze-out stocker

revenues (RGS-RFS) times the number of graze-out stockers.

Costs

Wheat (harvested)

The product of per-acre operating costs for wheat (CW) and the number of acres harvested.

Wheat (non-harvested)

The per-acre operating costs of non-harvested (CW-CGW) wheat times the number of acres of non-harvest wheat.

Fall/winter stocker

Per-head total operating costs for fall/winter stockers (CFS) times the number of fall/winter stockers.

Graze-out stockers

Reflects only the additional costs incurred during the graze-out period and are calculated as the product of cost per-head during graze-out (CGS-CFS) times the number of graze-out stockers.

The Net Return Summary for the representative production situation is reported in Table 2.8. The regular and non-participation options provide equal revenues and expenses from both wheat and stockers, but differ in that the regular option includes a \$21,600 deficiency payment. Under the 0/92 option, both revenue and expenses are decreased as compared to the other options. The highest return possible is achieved using the "regular" option with returns exceeding \$95,000. The "0/92" option provides the next highest return of approximately \$82,000. The returns generated under the "0/92" option are decreased because more acres must be set aside than are necessary for the number of stockers to be grazed-out. Net return under the non-participation option is \$73,515.

By manipulating the government program (e.g., increasing or decreasing flex acres), or changing the number of stockers to utilize the extra forage available from the government programs, the profitability of alternative production plans can be evaluated. It is important to modify the government programs and any of the variable inputs in order to evaluate all possible alternatives. By simulating different situations and scenarios, a more profitable plan might arise.

Sensitivity Analysis

The sensitivity analysis section of the model allows the user to evaluate the sensitivity of the net return estimates reported to various price and yield changes. The sensitivity analysis portion of the model is found by pressing ALT-I, and a sample screen is shown as Table 2.9. One could evaluate the effect of price and/or yield changes by inserting alternative price/yield projections in the budget input sections and recalculating the net return table. However, such an activity could be quite time consuming. The sensitivity analysis allows the user to evaluate the effect of varying any two of the following parameters: wheat price, wheat yield, fall/winter (March) stocker price, fall/winter ADG, graze-out (May) stocker price, and graze-out ADG. Completion of the sensitivity analysis provides a table of twenty-five net return estimates reflecting various combinations of the two parameters selected.

To conduct the sensitivity analysis, the policy option

is first selected by entering either a 1, 2, or 3 into cell (AW6). Next, the two parameters to be varied are selected by inserting a "1" in the horizontal column and a "1" in the vertical column under the "Variable Selection" column. The table values will report net returns under five levels for each of the selected parameters. The midpoint of each parameter's range is entered in the "Average" column. The value inserted in the "Increment" column defines the remaining four prices (yields) evaluated. This value and two times this value is added (or subtracted) from the midpoint to determine the four other values. For example, if an average wheat of \$3.00/bushel and an increment of \$.25/bushel were specified, the five wheat prices considered would be \$2.50, \$2.75, \$3.00, \$3.25, and \$3.50/bushel. ALT-Z is pressed to complete the sensitivity analysis and generate the table of results. The table can be viewed by pressing PgDn.

An illustration of the sensitivity analysis results is included in Table 2.10. Net returns under the "Regular" program option are calculated under 25 wheat and cattle price combinations. Net returns are estimated at a wheat price of \$3.00/bushel with \$0.25/bushel increments. Graze-out stocker price is set at \$72/cwt and varied by \$3.00/cwt increments. Given a worst case scenario, low wheat and steer prices, net returns are projected as \$55,741. Given the best case scenario, whole-farm net returns are estimated at \$134,488.

TABLE 2.1

FALL/WINTER STOCKER INPUT SCREEN

H	I	J	K	L	M
1	STOCKER INPUT:		FALL/WINTER GRAZING		
2					
3	PERFORMANCE DATA:		ECONOMIC DATA:		
4	Purchase Weight (lbs)	425	Calf Cost (\$/lb)		0.93
5	Days of Receiving Prog.	10	Exp. Sell Price (\$/lb)		0.80
6	ADG During Receiving	1.00	Interest Rate (%)		0.10
7	Days on Pasture	115	Vet & Med Exp. (\$/hd)		8.00
8	ADG on Pasture (lbs/day)	2.10	Marketing Chg. (\$/cwt)		1.72
9	Death Loss (%)	2	Hauling (\$/cwt)		0.35
10	Stocking Density (A/hd)	2.00	Mach & Equip. (\$/hd)		6.09
11			Beef Checkoff (\$/hd)		0.00
12			Misc. Expense (\$/hd)		0.00
13			Labor Cost (\$/hr)		5.00
14					
15	Revenue Option:	0	Pasture Cost:		0.00
16	0 = own cattle	XXX	0 = own pasture		XXX
17	1 = \$/lb of gain	0.25	1 = \$/acre		20.00
18	2 = \$/cwt/month	2.50	2 = \$/lb of gain		0.30
20			3 = \$/cwt/month		3.00
21					
22	FEED	Days Fed	(lbs/hd/day)		Cost (\$/lb)
23	Supplemental Hay	200	10.00		0.03
24	Supplemental Feed	0	4.15		0.07
25	Salt/Mineral	115	0.25		0.15
26					
27	LABOR	Hrs/hd/day	Days		
28	Receiving	0.05	10		
29	Feed/Check	0.07	11		
30	Misc.	0.00	0		

TABLE 2.2

STOCKER BUDGET: FALL/WINTER GRAZING

FALL/WINTER GRAZING	UNIT	PRICE	QUANTITY	VALUE
LIVESTOCK RECEIPTS:				
Stockers	cwt	80.00	6.63	530.38
Total Receipts				530.38
OPERATING INPUTS:				
Stocker Calves	cwt	92.50	4.25	393.13
Supplemental Feed	lb	0.07	0.00	0.00
Supplemental Hay	lb	0.03	200.00	6.00
Salt & Mineral	lb	0.15	28.75	4.31
Freight	cwt	0.35	6.77	2.37
Marketing	cwt	1.72	6.77	11.64
Vet-Med Expenses	hd	8.00	1.00	8.00
Mach. & Equip. Costs	hd	6.09	1.00	6.09
Interest Expense	dol	0.10	135.41	13.54
Labor	hr	5.00	1.27	6.35
Beef Checkoff	dol	0.00	1.00	0.00
Pasture Lease	acre	0.00	0.00	0.00
Miscellaneous	dol	0.00	1.00	0.00
Total Operating Costs				451.52
RETURN ABOVE OPERATING COSTS (\$/hd)				78.95
SHORT-RUN BREAKEVEN PRICE (\$/cwt)				68.09

TABLE 2.3
GRAZE-OUT STOCKER INPUT SCREEN

N	O	P	Q	R	S
1	STOCKER INPUT:	SPRING - GRAZE OUT			
2					
3	PERFORMANCE DATA:		ECONOMIC DATA:		
4	Days on Pasture	65	Selling Price (\$/lb)	0.72	
5	Exp. ADG (lbs/day)	2.50	Vet & Med Exp. (\$/hd)	3.00	
6	Death Loss (%)	2.00	Mach & Equip. (\$/hd)	2.45	
7	Stocking Density(ac/hd)	0.50	Misc. Exp. (\$/hd)	0.00	
8					
9					
10	FEED:	Days Fed	(Lbs/hd/day)		
11	Supplemental Hay	0	0.00		
12	Supplemental Feed	0	0.00		
13	Salt/Mineral	0	0.00		
14					
15	LABOR:	Hrs/day	Days		
16	Feed/Check	0.07	10		
17	Misc.	0.00	0		

TABLE 2.4

STOCKER BUDGET : SPRING/GRAZE-OUT

SPRING GRAZE-OUT	UNIT	PRICE	QUANTITY	VALUE
LIVESTOCK RECEIPTS:				
Stockers	cwt	72.00	8.22	591.84
Total Receipts				591.84
OPERATING INPUTS:				
Stocker Calves	cwt	92.50	4.25	393.13
Supplemental Feed	lb	0.00	0.00	0.00
Supplemental Hay	lb	0.03	200.00	6.00
Salt & Mineral	lb	0.15	28.75	4.31
Freight	cwt	0.35	8.39	2.94
Marketing	cwt	1.72	8.39	14.43
Vet-Med Expenses	hd	11.00	1.00	11.00
Mach.& Equip. Costs	hd	8.54	1.00	8.54
Interest Expense	dol	0.10	228.46	22.85
Labor	hr	5.00	1.98	9.90
Beef Checkoff	hd	0.00	1.00	0.00
Pasture Lease	acre	0.00	0.00	0.00
Miscellaneous	hd	0.00	1.00	0.00
Total Operating Costs				473.09
RETURN ABOVE OPERATING COSTS (\$/hd)				118.75
SHORT-RUN BREAK-EVEN PRICE (\$/cwt)				57.55
GRAZE-OUT RETURNS:				
Additional Revenue				61.62
- Additional Cost				21.67
-----				-----
= Net Return (Graze-Out)				39.95

TABLE 2.5
WHEAT INPUT SCREEN

U	V	W	X	Y	Z	AA
1	WHEAT INPUT:					
2						
3	INPUT QUANTITIES:			INPUT PRICES:		
4	Seed (bu/ac)	1.50		Seed (\$/bu)	7.50	
5	Nitrogen (lb/ac)	50		Nitrogen (\$/lb)	0.20	
6	Phosphorous (lb/ac)	25		Phosphorous (\$/lb)	0.10	
7	Other Nutrients (lb/ac)	10		Other Nutrients (\$/lb)	0.15	
8	Herbicide (appl.)	1		Herbicide (\$/appl.)	3.00	
9	Insecticide (appl.)	1		Insecticide (\$/appl.)	4.00	
10				Custom Harvest (\$/ac)	12.00	
11	PRICE & YIELD:			Custom Harvest (\$/bu)	0.00	
12	Expected Yield (bu/ac)	32.00		Custom Hauling (\$/bu)	0.10	
13	Expected Price (\$/bu)	3.00		Interest Rate (%)	0.13	
14				Miscellaneous (\$/ac)	0.00	
15	COSTS NOT INCURRED ON			Labor Rate (\$/hr)	5.00	
16	GRAZEOUT ACRES (\$/AC):	30.00				
17						
18	Calculate machinery and labor cost (Yes/No?)		YES			
19	(If "no", input cost and labor use below; if "yes", page down)					
20	Machinery Cost (\$/ac)	5.00		Labor (hrs/ac)	1.00	
21	MACHINERY COST INPUT:					
22						
23	Power Units	Cost (\$/hr)				
24	1 110 HP Tractor	7.13				
25	2 135 HP Tractor	8.39				
26	3					
27	4					
28						
29	Implements	Cost (\$/hr)				
30	1 Disc	2.69				
31	2 Chisel	2.53				
32	3 Springtooth	1.07				
33	4 Drill	3.98				
34	5 Fert. Spreader	3.00				
35	6					
36	7					
37	8					
38	9					
39	10					
40						
41						
42	Schedule of Operations:					
43		Power			Cost	Labor
44	Operation	Unit	Implement	Acres/hr	(\$/ac)	(hr/ac)
45	1 Chisel	2	2	6.25	1.75	0.19
46	2 Disc	2	1	6.67	1.66	0.18
47	3 Springtooth	2	3	10.00	0.95	0.12
48	4 Springtooth	2	3	10.00	0.95	0.12
49	5 Drill	2	4	3.45	3.59	0.35
50	6 Fertilize	1	5	10.00	1.01	0.12
51	7 Disc	2	1	6.67	1.66	0.18
52	8				0.00	0.00
53	9				0.00	0.00
54	10				0.00	0.00
55						
56	Total machinery variable costs (\$/ac)				11.57	
57	Total labor requirement (hrs/ac)				1.26	

TABLE 2.6
WHEAT BUDGET

WHEAT	UNIT	PRICE	QUANTITY	VALUE
CROP RECEIPTS:				
Wheat	bu	3.00	32.00	96.00
Total Receipts				96.00
OPERATING INPUTS:				
Wheat Seed	bu	7.50	1.50	11.25
Nitrogen	lb	0.20	50.00	10.00
Phosphorus	lb	0.10	25.00	2.50
Other Nutrients	lb	0.15	10.00	1.50
Herbicide	appl	3.00	1.00	3.00
Insecticide	appl	4.00	1.00	4.00
Custom Harvest	acre	12.00	1.00	12.00
Mach.& Equip. Costs	acre	11.57	1.00	11.57
Interest Expense	acre	0.13	37.59	4.89
Labor	acre	5.00	1.26	6.30
Custom Hauling	bu	0.10	32.0	3.20
Miscellaneous	acre	0.00	1.00	0.00
Total Operating Costs				70.21
RETURN ABOVE OPERATING COSTS (\$/ac)				25.79
SHORT-RUN BREAKEVEN PRICE (\$/bu)				2.19
SHORT-RUN BREAKEVEN YIELD (bu/ac)				23.40

TABLE 2.7

WHOLE-FARM AND GOVERNMENT INPUT SCREEN

AB	AC	AD	AE	AF	AG	AH	AI
1	WHOLE FARM AND GOVERNMENT PROGRAM INPUTS:						
2							
3	Target Price (\$/bu)					\$4.00	
4	Regular Loan (\$/bu)					\$2.58	
5	Emergency Loan (\$/bu)					\$2.21	
6	Guaranteed Deficiency, 0/92 (\$/bu)					\$1.00	
7	Percentage Set-Aside (%)					5	
8							
9	ASCS Program Yield (bu)					30	
10	Five-Month Average Price (\$/bu)					3.10	
11	Twelve-Month Average Price (\$/bu)					3.2	
12							
13	Total Cropland in Wheat (acres)					1200	
14	Program Base Acres (acres)					1000	
15	Number of Stockers (Fall/Winter) (head)					500	
16	Number of Stockers (Graze-out) (head)					490	
17							
18	* Note: Maximum number of graze-out stockers is						500
19							
20							
21	POLICY OPTIONS:						
22	Regular Option:						
23	Percentage Flex Acres				15.00%		
24	Flex Acres Harvested				150		
25							
26	* Note: Flex acres = minimum 15% + (0-10%) optional flex						
27							
28							
29	0-92 Option:						
30	Base Acres Harvested				782		
31							
32	* Note: Maximum acres harvested =				782		
33							
34							
35	Non-Participation Option:						
36	Acres Harvested				950		
37	Acres For Graze-out				250		
38							
39	* Note: Acres required to graze out all F/W stockers =					250	
40							
41	PRODUCTION SUMMARY:						
42				Non-Part.	Regular	0/92	
43							
44	Acres Harvested		950	950	782		
45	Acres for Graze-out		250	250	418		
46	No. of Head (Fall/Winter)		500	500	500		
47	No. of Head (Graze-out)		490	490	490		
48							
49							
50	DEFICIENCY PAYMENT SUMMARY:						
51							
52	Expected Regular Deficiency Payment (\$/bu)				0.90		
53	Expected Emergency Deficiency Payment (\$/bu)				0.00		
54	Deficiency Payment Acres				800		

TABLE 2.8

WHOLE-FARM NET RETURNS UNDER THREE ALTERNATIVE OPTIONS

FINAL NET RETURN			
REVENUE	Non-Part.	Regular	0/92
Deficiency Payments	\$0	\$21,600	\$19,734
Wheat	\$91,200	\$91,200	\$75,072
Stocker (Fall/Winter)	\$265,188	\$265,188	\$265,188
Stocker (Graze-Out)	\$30,195	\$30,195	\$30,195
TOTAL REVENUE	\$386,583	\$408,183	\$390,189
COSTS			
Wheat (Harvested)	\$66,690	\$66,690	\$54,896
Wheat (Non-Harvested)	\$10,050	\$10,050	\$16,803
Stocker (Fall/Winter)	\$225,711	\$225,711	\$225,711
Stocker (Graze-Out)	\$10,618	\$10,618	\$10,618
TOTAL COSTS	\$313,068	\$313,068	\$308,028
NET RETURN	\$73,515	\$95,115	\$82,161

TABLE 2.9
SENSITIVITY ANALYSIS INPUT SCREEN

	AQ	AR	AS	AT	AU	AV	AW
--	----	----	----	----	----	----	----

1

2

3 SENSITIVITY ANALYSIS

4

5

6 Which policy option do you wish to evaluate? 2

7 (1 = non-part., 2 = 5 month, 3 = 0/92)

8

9 Variable Selection

10 Horizontal Vertical Average Increment

11 Wheat price 1 0 3.00 0.25

12 Wheat yield 0 0 32.00 4.00

13 F/W stocker price 0 0 0.80 0.03

14 F/W stocker ADG 0 0 2.10 0.20

15 GO stocker price 0 1 0.72 0.03

16 GO stocker ADG 0 0 2.50 0.20

17

18 Press alt Z to generate sensitivity analysis results

19

20 (Page down to view results)

TABLE 2.10

SENSITIVITY ANALYSIS OF NET RETURNS UNDER NON-
PARTICIPATION, REGULAR, AND 0/92 OPTIONS

NON-PARTICIPATION OPTION			Wheat Price			
			2.5	2.75	3.00	3.25
3.5						
G/O	0.66 :	34,141	41,741	49,341	56,941	64,541
Stocker	0.69 :	46,228	53,828	61,428	69,028	76,628
Price	0.72 :	58,315	65,915	73,515	81,115	88,715
	0.75 :	70,401	78,001	85,601	93,201	100,801
	0.78 :	82,488	90,088	97,688	105,288	112,888
REGULAR OPTION			Wheat Price			
			2.5	2.75	3.00	3.25
			3.5			
G/O	0.66 :	55,741	63,341	70,941	78,541	86,141
Stocker	0.69 :	67,828	75,428	83,028	90,628	98,228
Price	0.72 :	79,915	87,515	95,115	102,715	110,315
	0.75 :	92,001	99,601	107,201	114,801	122,401
	0.78 :	104,088	111,688	119,288	126,888	134,488
0/92 OPTION			Wheat Price			
			2.5	2.75	3.00	3.25
			3.5			
G/O	0.66 :	45,475	51,731	57,987	64,243	70,499
Stocker	0.69 :	57,562	63,818	70,074	76,330	82,586
Price	0.72 :	69,649	75,905	82,161	88,417	94,673
	0.75 :	81,735	87,991	94,247	100,503	106,759
	0.78 :	93,822	100,078	106,334	112,590	118,846

CHAPTER III

AN ECONOMIC ANALYSIS OF WHEAT PASTURE SUPPLEMENTATION PROGRAMS

The relatively high quality of wheat pasture in Oklahoma makes the practice of supplementation seem unnecessary. Crude protein levels for young growing wheat can range from 20 to 30 percent (Wagner, 1984). The potential gains can also be excellent, ranging from 0.5 to 2.8 lbs/day (not including the graze-out period) (Horn, et al., 1984). Gains typically range from 1.5 to 2 lbs/day. The problem therein is not one of quality, but one of quantity. In many cases, gains and carrying capacity are reduced because of a lack of available forage to the animals. If conditions are ideal, animal performance on wheat pasture can be excellent. Adequate forage stocks are one of the most important considerations when determining whether or not to graze. Incorporation of a supplementation program can be used to replace forage in deficit periods, extend available forage for longer periods of time, or increase the number of cattle grazed.

With a supplemental feeding program, it is also possible to feed an ionophore or other types of feed additives. Currently, two ionophores, Rumensin(or monensin) and Bovatec(or lasalocid), are cleared for feeding to pasture

cattle. Ionophores are a class of antibiotic that depresses or inhibits the growth of specific rumen microorganisms. This selective inhibition alters rumen fermentation in three major ways: (1) improving efficiency of energy metabolism by changing the types of volatile fatty acids and decreased energy lost during fermentation, (2) decreasing the breakdown of feed protein, and, (3) decreasing microbial protein synthesis. Ionophores have been shown to reduce the incidence of acidosis, bloat, and coccidiosis(Stock, et al.).

Supplemental feeding programs can be designed to add flexibility in livestock feeding operations. For example, producers who wish to increase stocking density and graze wheat more intensively can do so while still maintaining gains. Producers who are concerned with low forage production levels can implement feeding programs to maintain gains even in times of forage deficits. Supplemental feeding programs are also useful and convenient delivery vehicles for feed additives, minerals and medicine. Probably the biggest advantage is that extra cattle can be grazed during the fall/winter season and will be on hand to utilize the extra forage production in the spring.

Supplementation programs may also be used to decrease the variability of weight gains(i.e. less variation going into the feedlot), thereby decreasing risk and potentially increasing average daily gains. Reduction in the variability of weight gains and death loss will translate to less income variability and an overall reduction in the economic risk facing wheat

stocker producers. One of the main objectives of current wheat pasture research is "to develop supplementation programs for delivery of new technologies that will decrease production risks of growing cattle on wheat pasture and increase the stability of the enterprise" (Horn, et al., 1991).

Along with the increased gain potential, reduced risk and added flexibility comes several other important benefits that must be considered (e.g., decreased death loss, reduced medical expenses). A more complete understanding of all aspects of a supplemental feeding program is needed, especially the economic considerations.

Three years of experimental data is used to evaluate the economic impact of alternative supplementation strategies on the grazing system. An enterprise analysis as well as a whole-farm study is conducted. Experiments conducted by the Oklahoma State University Animal Science Department at Marshall, Oklahoma are used to evaluate supplementation programs.

Experimental Design

The effects of supplementation on animal performance were studied over a three year period, using three full growing/grazing seasons. In each of the experiments, fall weaned cross-bred steer calves were allotted to different treatments. Steers grazed clean tilled wheat pasture (Pioneer 2157) for 115, 107, and 84 days, during the 1989-90, 1990-91, and 1991-92 growing seasons, respectively. Treatment steers

received supplemental feed for 96, 100, and 69 days of the grazing period, respectively. Steers received either no supplement, a high-starch, or a high-fiber ration. Control cattle received no supplement other than a free-choice commercial mineral. Supplemented cattle were hand-fed a high-starch (corn based) or a high-fiber energy supplement six days/week. Target consumption was initially set at .75 to 1% of mean body weight. The 1989-90 season experiment included a fourth treatment in which cattle were fed the high-fiber ration *ad libitum*. Gains tended to decrease; therefore, this experiment was not replicated in the following years. Ingredients and nutrient specifications of the rations are included in Table 3.1. All of the rations contained monensin (about 40 mg/lb).

In year 1 stocking density was increased 33% (from 2 to 1.5 acres/head) on pastures where the energy supplements were fed. In year 2 (1990-91), stocking rates were set at levels of 2, 1.64, and 1.38 acres/head. Control, high-starch, and high-fiber cattle were allotted to each of the different stocking densities. In year 3 (1991-92), levels were once again set at levels of 2 and 1.5 acres/head for the control and supplementation treatment, respectively.

Experimental Results

Results of the supplementation experiment can be seen for the 1989-90, 1990-91 and 1991-92 production seasons in Tables 3.2, 3.3, 3.4, respectively. In year 1 (1989-90), control

cattle gained 2.14 lbs/day, high-starch treatment cattle gained 2.19 lbs/day, and high-fiber cattle gained 2.35 lbs/day. Gains tended to decrease ($P < .10$) as a result of feeding the high-fiber supplement free-choice as opposed to hand feeding. Hence, the free-choice feeding alternative was not replicated in the following years. Steers consumed approximately 4.2 pounds of supplement per day. Conversion of supplement, expressed as pound of supplement(as-fed) per pound of increased gain per acre, was 4.88 for the high-fiber supplement, and 6.54 for the high-starch supplement.

Year 2 (1990-91) results are reported in Table 3.3. Weight gains increased under both supplementation programs by about .41 lb/day, with the response being similar at all three stocking densities. In contrast to year 1, gains of cattle fed the high-fiber versus high-starch corn-based energy supplement were not statistically different ($P = .85$). Supplement consumption was about 3.85 pounds per day. Mean conversion of the supplement, expressed as pounds of supplement per pound of additional gain, was 5.00 and 5.25 for the high-starch and high fiber, respectively. These conversions are similar to those experienced in year 1, but are substantially lower than conversions experienced in past supplementation programs (9 to 10 lbs of feed/lb of additional gain).

Year 3 (1991-92) results are summarized in Table 3.4. Supplement consumption decreased in year 3; high-starch steers consumed an average of 2.46 lbs/day, while high-fiber steers

consumed 3.66 lbs/day. Control steers gained 2.19 pounds/day, and treatment steers gained an average of 2.51 pounds/day. Supplement conversions improved relative to the first two years. Supplement conversions for the high-starch and high-fiber treatment were 2.4, and 3.31 pounds of supplement per pound of increased gain per acre.

If the three years of performance data are averaged, the effects on key production variables are as follows: (1) average daily gains are 2.11, 2.35, and 2.40 pounds per day for the control, high-starch, and high-fiber treatments, respectively; (2) gains per-acre are 116 pounds for the control treatment, 156 pounds for the high-starch, and 146 pound for the high-fiber treatment; (3) average consumption, expressed as percent of body weight, was 0.57% for the high-starch treatment and 0.66% for the high-fiber treatment. High-starch supplement conversion averaged 4.45 pounds of supplement per pound of increased weight gain, while the high-fiber treatment averaged 4.48 pounds of supplement per pound of increased weight gain. Supplement conversion improved during the third year. Researchers suspect that the low forage production levels during this year are responsible for the improved conversion. Other key production variables behaved consistently across all years.

The three years of experimental data show that gains as well as stocking density can be increased by utilizing a supplemental feeding program. Other benefits that are not specifically addressed above, but should be considered, are:

(1) decreased losses from bloat due to the ionophore and other types of feed additives included, (2) inclusion of minerals that may be deficient in forage, and (3) the added flexibility provided by the program when making managerial decisions. Although it is difficult to estimate the value of these benefits, it should be recognized that they can make a significant contribution to farm returns.

Although it has been shown that supplemental feeding of a high-starch or high-fiber ration will improve gains and increase stocking density, the profitability of such a program has not yet been determined. The economic feasibility of the supplementation programs will first be evaluated by using an enterprise budgeting approach. Net returns will be estimated for each of the three years of experimental data, as well as a production situation reflecting average livestock performance and price conditions. Next, the supplementation strategies will be examined using a whole-farm analysis, including government program options available to producers. The whole-farm analysis will capture any potential economic benefits of the increased stocking density (i.e. more cattle are grazed and marketed).

Enterprise Budgeting Analysis

Enterprise Budget Assumptions

Cattle prices used in the analysis were the actual prices from the appropriate month and year of each experiment

(Oklahoma City Livestock Market). November steer prices were used to determine calf purchase price, March feeder prices were used to determine spring selling price, and May feeder prices were used for the sale price of graze-out steers. Because these prices are reported in 100 pound intervals, it was necessary to interpolate between prices to arrive at an actual price for each weight for each year. Livestock prices used to represent "average" production conditions were selected to reflect the average gross margin (\$/head) over the 1983-92 period. The gross margin is the difference in the purchase and sale price of the calf. The average calf price in this period was \$83.47/cwt (1992 dollars). The March and May sale prices were then adjusted to yield the average gross margin (\$/head) over the 10-year period. Feeder prices resulting from this procedure were \$76.15 and \$74.97/cwt for March feeders (unsupplemented and supplemented) and \$70.38 and \$69.72 for May feeders (unsupplemented and supplemented).

Feed costs were approximately \$7.00/cwt for all rations. This included the ingredient cost, a \$30.00/ton milling charge, and a \$12.00/ton bulk delivery charge. Mineral expense for the supplemented calves was included in the cost of the supplement; non-supplemented cattle were fed a commercial mineral at a rate of 0.25 lb/day.

Labor requirements were divided into two components: labor required to feed energy supplement and a base labor requirement that includes labor used in receiving cattle, checking cattle, etc. The base labor requirement was 1.27

hours/head for the cattle stocked at a density of 2 acres/head, and 1.09 hours/head for a stocking density of 1.5 acres/head. Additional labor used to feed the energy supplement was estimated at .96 hour/head. Labor was valued at \$5.00 per hour. Machinery and equipment costs primarily reflect fuel, lubrication, and repair expenses for a 3/4 ton pickup and were estimated using machinery cost calculations from the Oklahoma State University Enterprise Budget Generator. Veterinary expenses were \$8.00 per head and include implants, eartags, worming and vaccinations, as well as a prorated share of sickpen charges. Hauling and marketing charges were assessed at rates of \$.35/cwt and \$1.72/cwt, respectively. Interest on operating capital reflects the cost of capital used to purchase the calf and other expense items, and was estimated based upon an annual interest rate of 12 percent.

The value of fall-winter wheat pasture was set at \$17.40 per acre. *Oklahoma Pasture and Cropland Rental Rates: 1990* reported wheat pasture rental rates ranging from \$2 to \$45 per acre and a state-wide average of \$17.40/acre. Using this value, pasture costs for fall-winter stockers ranged from \$26.10 per head for supplemented cattle to \$34.80 per head for the control cattle. The same survey indicated an average rental rate of graze-out pasture (March-May) of \$28.00/acre.

The graze-out enterprise was assumed to last 65 days, with steers gaining an average of 2.50 pounds/day. Additional veterinary and medical expenses were \$5.00 per-head and

reflect the cost of re-implanting and re-worming, etc. Additional machinery and equipment costs were \$3.45 per head. Labor costs also increased because of the time necessary to check cattle during the graze-out season. There was no supplemental feeding during the graze-out season; cattle received only a commercial mineral mixture fed at a rate of 0.10 lb/day. The stocking density was set at 0.5 acres/head. Returns above operating cost for the graze-out budget included the fall/winter grazing season as well. This was done to provide more information about the total costs necessary to take cattle from November through the entire graze-out season.

The wheat budget was developed in a manner similar to the livestock budgets. Wheat production costs were the actual costs incurred at the Marshall, Oklahoma experiment station. Wheat price is the 3 year (1990-1992) average June wheat price received by Oklahoma farmers. It was assumed that wheat is sold in June of each production year. The three year average grain yield at the Expanded Wheat Pasture Research Station (15.9 bushels/acre) for Pioneer 2157 was used in the analysis (Krenzer, et al., 1992). These relatively low wheat yields caused wheat returns to be significantly lower than would normally be expected.

The actual operating costs information from the trials was also used. One and one-half (1.5) bushels of wheat were sown per acre at a value of \$4.50/bushel. Fertilizer (18-46-0) was applied in the fall at a rate of 100 pounds/acre, and 120 pounds of anhydrous ammonia was applied in August. Aerial

applications of Glean and Rhonex were also applied at a cost of \$2.52 and \$0.95 per acre, respectively. Custom harvest charges were \$12.00 per acre. Machinery and equipment charges were \$9.48, while labor requirements were set at 3.08 hours/acre. Labor was valued at \$4.50/hour. Interest expense on operating inputs was calculated to be \$4.54/acre using an annual interest rate of 12 percent.

Total operating costs for harvested acres were \$78.23 per acre. Operating cost for wheat that was grazed-out was valued at \$66.23. Graze-out acres were not assessed any harvest costs. Returns listed on the budgets are per-acre returns above operating costs.

Enterprise Analysis Results

Table 3.7 provides the per-head and per-acre returns during the fall/winter and graze-out seasons for a representative grazing year and for each of the three years. Net returns in each year reflect actual gains observed in the experiments and actual livestock prices. To create a representative grazing year, all three years of production data were averaged. Livestock prices were selected to reflect average profit potential over the 1983-92 period (1992 dollars). Prices from the Oklahoma City Livestock Markets were again used.

A break-down of expense and revenue information for control and treatment cattle during both the fall/winter and graze-out seasons is included in Tables 3.5 and 3.6. Livestock gains

and prices reflect production conditions for the "average" year. Several expenses were increased as a result of implementing the supplementation programs. The most significant increases occur in the feed, labor, and machinery operating cost categories. Average feed cost increased \$23.32/head. Machinery and equipment costs were increased \$1.89/head, and labor costs increased \$3.90 head. Hauling and marketing costs increased nominally as a result of selling heavier cattle, \$0.11 and \$0.52/head, respectively. An expense that was lowered through supplementation is pasture cost, due to the increased stocking density.

The profitability of the supplementation program depends on whether revenues from additional gains are sufficient to cover these additional expenses. Fall/winter returns for control cattle in the "average" year were \$29.02/head and \$14.51/acre. Supplemented cattle gained an average of 32 pounds more than control, but increased costs by \$18.80 per-head. Supplemented cattle returned \$25.64/head and \$17.09/acre during the fall/winter grazing season.

During the graze-out period, control cattle returned \$15.58 and supplemented cattle returned \$15.41. Per-acre returns were \$31.16 for control and \$30.82 for supplemented cattle. The net return per-acre during graze-out is a key variable in determining the profitability of a supplemental feeding program. In order for supplementation to be profitable, more cattle must be grazed; therefore, more acres are required during graze-out, and overall profits can be

increased. Total returns over the entire grazing period were \$44.60 and \$41.05 per head for the control and supplemented cattle, respectively.

Results from the first year of experimental data (1989-90) indicate that both per-head and per-acre returns were decreased by incorporating a supplemental feeding program. During the fall/winter season, expenses for treatment cattle were \$22.57/head more than control cattle, while revenue was only increased \$6.89/head by feeding the supplement. The per-head difference is \$15.67/head in favor of the control cattle. Even though pasture cost was reduced for the supplemented cattle, this savings was not sufficient to cover the extra expenses incurred. The difference does decrease when expressed on a per-acre basis; returns per-acre for the control cattle were \$15.58 while supplemented cattle returned \$10.32.

Graze-out returns were similar in both programs at \$66.53/head (\$133.06/acre) for control cattle and \$66.67/head (\$133.34/acre) for supplemented cattle. This return is on the graze-out acres only, which will be fewer in number, but returns are substantially higher than per-acre returns during the fall/winter grazing period. Total returns for the entire grazing season were \$97.68 and \$82.15 per head, for the unsupplemented and supplemented cattle, respectively.

Year 2 (1990-91) results for the fall-winter period are

similar to those of year 1.¹ Unsupplemented cattle returned \$43.52/head, and supplemented cattle earned returns above operating costs of \$22.58/head. Although gains were increased and pasture costs were decreased from the supplementation program, these costs were not sufficiently lowered to make the program as profitable as a non-supplementation program.

Graze-out returns were significantly lower in year 2. Control cattle earned an additional \$19.96/head (\$39.32/acre) and supplemented cattle earned \$23.59/head (\$47.18/acre). Per acre returns must again be considered along with the fact that more acres are required to graze-out the extra steers on pasture.

The enterprise analysis for year three (1991-92) indicates negative returns for both the control and treatment cattle during the fall-winter grazing season. Unsupplemented steers lost \$7.62/head and \$3.81/ acre. Supplemented cattle produced a slightly larger net return than control steers, although they still incurred a loss of \$6.34/head and \$4.23/acre. Year 3 was the first year that returns for the treatment cattle were greater than the control cattle. The negative returns may be primarily attributed to the short length of the fall/winter grazing. Due to limited forage availability, cattle were only grazed for 86 days, almost a full month less than previous years.

Additional returns earned during graze-out are sufficient

¹ As in year 1, control cattle were stocked at 2 acres/head, while treatment cattle were stocked at 1.5 acres/head. In order to achieve a 1.5 acres/head stocking density the results of the 1.64 and 1.38 acres/head treatments were averaged.

to provide positive returns for both groups. Control cattle generated additional returns of \$19.75/head (\$39.50/acre) The graze-out period contributed an additional \$20.51/head (\$41.02/acre) to net returns from supplemented cattle. As a result, returns from the entire grazing season were \$14.17/head under supplementation and reduced to \$12.15/head without supplementation. The longer time on pasture allowed the steers to overcome the relatively high start-up costs and show a profit. The whole-farm analysis for year three should be advantageous for the supplementation program. Not only are per-head returns higher, but the stocking density effects will also favor the treatment cattle.

The enterprise budgeting analysis shows that per-head and per-acre returns were decreased in two out of three actual production years by utilizing a supplemental feeding program. During the year that returns were larger under the supplementation program, negative returns during fall-winter grazing occurred. The creation of a representative year, which reflected an average of the three years of production data and ten years of price data, shows that returns were slightly decreased by utilizing a supplemental feeding strategy. The extra weight gain was not sufficient to cover the extra expenses incurred by the program.

However, the economic significance of the other possible benefits (i.e. decreased death loss from bloating, increased stocking density, increased flexibility, etc.) must be considered as important, positive aspects of the program. One

of the advantages of utilizing a supplemental feeding program is the ionophore which it includes. Ionophores decrease bloat in wheat pasture cattle, which should translate to a decrease in death loss. Ionophores also decrease the incidence of coccidiosis, which also will decrease death loss and enhance performance. Minimizing death loss is one of the key elements to successful stocker management. Using the "average" year for analysis purposes, it was found that a 1.85 percent decrease in death loss will completely offset the cost of a supplementation program. This decrease in death loss will result in a break-even situation between the treatment cattle and control cattle on a per-head basis.

Land is typically the limiting resource in agricultural production. Land costs are a substantial portion of the operating costs of a wheat pasture grazing enterprise and significantly affect the relative profitability of supplementation. In this analysis, fall-winter pasture is valued at \$17.40/acre and increasing stocking density from 2 to 1.5 acres/head decreases pasture costs by \$8.70/head. If pasture was valued at \$25.00/acre, pasture costs would be \$12.50 per head lower under supplement. This savings would be sufficient to increase per-head returns from supplementation above the control cattle under "average" conditions. However, the effect will not be as dramatic if pasture cost is on a \$1cwt/month option.

The increase in stocking density is one of the other major advantages of a supplementation program. More cattle

can be grazed on the same amount of pasture while maintaining, or improving gains. An important question is "what percent increase in stocking density is necessary for supplemented cattle to return as much as control cattle per-head?". Results from these three years of analysis indicate that an additional increase in stocking density from 1.5 to 1.3 acres/head would allow average per-head returns from the supplemented cattle to exceed returns from the control cattle.

Improvements in any of these areas will cause the relative profitability of supplementation to improve. The combined effects have the potential of greatly improving the overall profitability of the practice. Although several costs are increased, the combination of increased stocking density and decreased death loss should decrease pasture costs, medical costs, and death losses enough to offset these additional costs.

While the enterprise analysis shows that returns are typically decreased by utilizing a supplemental feeding program, one of the key variables is not included in this type of analysis, the stocking density effect. The whole-farm analysis that follows will show this aspect of the program as well as those provided here.

Sensitivity Analysis

Sensitivity analysis provides a simple, efficient way to determine the effects of alternative price combinations on net returns. Each producer's production and price information

will differ to some degree. For managers having more favorable production and/or market conditions, this analysis may represent their operation more precisely. Sensitivity analysis also allows producers to examine the possible effects of year to year price and production changes.

The relative prices of both cattle and the supplement play major roles in determining the profitability of the practice. The sensitivity of per-head and per-acre returns to these two prices is reported in Table 3.8. Both steer and supplement prices were varied from their average levels to reflect alternative price situations. The moderate cattle and feed prices reported here are those used in the enterprise budgeting analysis presented above. Feed prices were varied \$2/cwt from the moderate level used earlier (moderate + \$2/cwt = high price, moderate - \$2/cwt = low price). Cattle prices were set to represent situations of high, moderate, and low profit potential, based upon the ten-year net return series described earlier. Calf price remained constant, and the sale price was adjusted to reflect situations of low, moderate, and high potential profitability from stocker production.² Alternative price scenarios were then developed by combining the three cattle prices and the three feed prices in various combinations.

Because control cattle were not given any supplemental

²Price spreads between November calves and March feeders were 3.00/cwt (high gross margin) and \$12.00/cwt (low gross margin), and price spreads between November calves and May feeders were \$7.00/cwt (high) and \$19.00/cwt (low). It is important to remember that a high gross margin means that there is a narrow spread between the two prices, hence higher profits.

feed, only steer price was varied. Both steer and feed prices were varied for the supplemented cattle. Given the worst case scenario, low cattle and high feed prices, the supplemented cattle had a loss of $-\$14.52/\text{head}$ and $-\$9.68/\text{acre}$ during the fall-winter season. Control cattle returned $-\$10.47/\text{head}$ and $-\$7.04/\text{acre}$. Under the best case scenario, high cattle and low feed prices, supplemented cattle returned $\$63.75/\text{head}$ and $\$42.50/\text{acre}$, and control cattle returns were $\$59.27/\text{head}$ and $\$29.63/\text{acre}$.

Per-head net returns under the supplementation program exceed returns from the control cattle in three of the nine scenarios. These three price situations all reflect low per-unit costs of supplemental feed. Per-acre net returns are higher under supplementation in six of the nine scenarios. Only in cases of low potential returns from stocker production combined with moderate or high feed and moderate cattle returns combined with high feed are per-acre returns lower under supplementation.

Whole-Farm Analysis

To conduct the whole-farm analysis, a 1000-acre management unit was constructed and assumed entirely planted to wheat. The stocker budgets constructed for the "average" year of the enterprise analysis were combined with the wheat budget to create a complete wheat-stocker production system. Government program provisions available during the 1991-92 production season were used in conducting the whole-farm

analysis. Whole-farm analysis allows one to better incorporate the effects of grazing-out stockers and government wheat program provisions into the economic evaluation.

Calves were assumed purchased in November and stocked at densities consistent with the grazing trials in Marshall, Oklahoma -- 2 acres/head (500 calves) for the no-supplement program and 1.5 acres/head (667 calves) for the supplementation program. During the graze-out season, steers were stocked at 0.5 acres/head from mid-March to May. A small decrease in cattle numbers between fall/winter and spring grazing occurs as a result of the fall/winter death loss. Other assumptions of the stocker budgets have been explained in the enterprise analysis.

The government program options available to producers during this time period were the "Regular" and "0/92" options. Both options were evaluated and compared against a "Non-Participation" option. All 1,000 acres on this farm were assumed to be base wheat acres, with an ASCS program yield of 35 bushels/acre. If it is not possible to graze-out all steers under the program provisions, a portion of the cattle were sold prior to the spring grazing season. The remainder were grazed-out and sold in May.

Under the "Regular" option, 20 percent of the total base was not eligible for deficiency payments. This acreage included the portion of base used for the Acreage Reduction Program (some refer to as set-aside, 5% for 1992) and the 15% Mandatory Non-payment Acres (or normal flex acres). Under

"0/92", producers may devote up to all of their maximum payment acres to conservation uses and still receive 92% of their deficiency payment. Target price for the 1991-92 production year was set at \$4.00/bushel, the 5-Month average price used was \$3.00/bushel, and the expected cash price is \$3.00/bushel. While individual operations and government program provision will change, the analysis will provide an indication of the profitability of supplementation under a variety of program alternatives and economic conditions.

Whole-Farm Analysis Results

Results of the analysis can be found in Tables 3.9 and 3.10. Farm level returns were estimated with and without the use of a supplementation program. The number of acres harvested and number of head in each stocker enterprise is reported at the top of each table. Total number of head grazed in the fall/winter season (500 with supplementation and 667 without supplementation) reflects the stocking densities used in the field experiments (2 acres/head for control and 1.5 acres/head for supplemented). The number of stockers grazed out was determined by the number of non-harvested acres associated with each program alternative.

Total revenues and costs are broken down by enterprise to provide an indication of the contribution of each enterprise to total net returns. Fall/winter stocker revenues reflect income earned had all cattle been sold in mid-March, while graze-out returns reflect additional revenue earned during the

graze-out period. Graze-out costs also reflect the additional costs incurred during the graze-out period. The net return reported is a return to fixed factors of production and does not include fixed costs of farm machinery or a land charge.

Under the no-supplement alternative, 500 stockers were grazed through the fall/winter period and 490 were carried through the graze-out period. The difference between the number of head during fall/winter and graze-out reflects the 2 percent death loss. Differences in the number of acres harvested across program options reflects the difference in non-harvested acres required to comply with the alternative wheat programs. Under the supplementation option, 667 head of steers were grazed through the fall/winter period. To graze all of these steers out, 334 acres were required. Under the "Regular" option with 5 percent set-aside and 15 percent mandatory non-payment acres, a portion of the herd would have to be sold. Since only 200 acres would be non-harvested (50 set-aside acres and 150 normal flex acres), only 400 steers could be grazed-out. In this case, because of the low profitability of the wheat enterprise, it is more profitable for the producer to opt for additional flex acres and graze-out all of the stockers.

Implementation of the supplementation program increased farm-level net returns under all three options. The increases in net returns were \$11,797, \$9,006 and \$11,797 for the non-participation, "Regular" and "0/92" options, respectively. The highest net return level was obtain by utilizing the

"0/92" option with a net return of \$47,803. The "0/92" option provides the flexibility to graze-out all of the supplemented stockers while maintaining deficiency payments at high levels. However, under the "Regular" option only 600 of the steers can be grazed-out. The producer may opt for a maximum 25 percent flex acres, which when combined with the 5 percent set-aside provides 300 acres for graze-out.

Large losses generated by the wheat enterprise make the results of this analysis somewhat unrepresentative of normal production conditions. Low grain yields are the primary reason for the \$32.12 per acre loss on harvested wheat acreage. Tables 3.11 and 3.12 report farm-level net returns under more representative wheat yields. An average yield of 30 bushels/acre is used, which reflects the 10-year average for Oklahoma. Net returns range from \$40,914 to \$69,099 under the no-supplementation program, and from \$49,276 to \$77,441 for the supplementation program. Increases derived from supplementation are slightly lower than above and range between \$8,342 and \$8,362. In this case, it is most profitable for the producer to opt for the minimum 15 percent flex acres and harvest 800 acres under the "Regular" option. Therefore, only 400 steers are grazed out under this option.

As stated earlier, benefits accruing from supplementation may be derived from increases in returns during both the fall/winter and graze-out phases. How were these benefits distributed between the two enterprises in this situation? Returns above operating costs from fall/winter grazing

increased from \$31,895 (\$266,905-\$235,010) to \$40,313 (\$366,356-\$326,043) as a result of implementing the supplementation program. This increase was derived entirely from the higher stocking density, because supplemented calves returned \$4.38 per head less in the fall/winter period (see Table 3.7). Therefore, under the cost and return situation presented, supplementation is not profitable if the increased carrying capacity is not utilized. If all calves were grazed-out, returns above operating costs for the graze-out enterprise were \$14,509 and \$19,241 under the no-supplementation and supplementation programs, respectively. Therefore, potential returns from livestock production increased approximately \$13,150 from supplementation; approximately 64% of this return was derived from fall/winter grazing, while 36% was attributed to graze-out.

The profitability of the supplementation program is partially dependent upon the specific provisions of the wheat commodity program. The relative profitability of supplementation increases as the percentage of non-harvested acreage required to achieve program compliance increases. Increased stocking densities associated with supplementation can provide an opportunity to more efficiently utilize unharvested acreage. As an illustration, in the 1990-91 production year the set-aside percentage was set at 15 percent. Therefore, under the "Regular" option, a minimum of 30 percent of the base acres (15 percent set-aside and 15 percent Mandatory Non-Payment Acres) were not eligible for

deficiency payments. Under the stocking densities used above, 245 acres are required to graze-out all of the stockers if they are not supplemented. Since 300 acres are not harvested (30% of 1,000 acres), the unharvested acreage is not efficiently utilized. Additional cattle could be purchased to utilize excess pasture; however, seasonal price trends usually negate the possibility of earning a positive return over such a short grazing period. If supplementation was employed, an additional 164 steers would be available for graze-out and the unharvested acreage would be fully utilized.

Sensitivity Analysis

Net returns for all three program options are presented in Table 3.13 for the nine price scenarios described earlier. As illustrated in the enterprise analysis, the profitability of the supplementation program is dependent upon feed prices and the potential profitability of stocker production (i.e., the price spread between November calves and March and May feeders). Under moderate and high potential returns from stocker production, whole-farm returns are higher under supplementation regardless of feed prices or the program option. Only when low cattle prices are combined with moderate or high feed prices is the supplementation program unprofitable.

Conclusions

The results of three years of experimental data have

shown that a supplemental feeding program can increase gains and stocking density. Other possible benefits have also been brought to light. The economic analysis of these alternative feeding programs has shown that per-head and per-acre returns were decreased by utilizing a supplemental feeding program in two of the three years. However, per-acre returns were increased by supplementation under "average" production conditions. The whole-farm analysis results show that returns were increased by using the program, because more cattle were grazed and more pounds of beef were sold. The importance of government deficiency payments should also be evident.

The stocking density effect is very important to the profitability of the program. An increase in stocking density (.2 head/acre) or a decrease in death loss (1.85%) will offset the cost of the feeding program and create a breakeven situation under "average" price and cattle performance conditions.

Inclusion of a supplementation program will bring about more risk. Some producers will value this program more than others, depending on their attitudes about risk and their capacity to utilize the program. The amount of capital required increases due to the extra cattle purchased, as well as the extra feed, labor, and machinery costs. Not only will production risk be increased with more intense grazing and increased input costs, price risk will also increase because more livestock are grazed. A sudden downturn in the cattle market could be devastating. These risks are not new to

wheat/stocker producers, they are only increased. The program was designed to decrease variability of gains, which will decrease one form of production risk. However, one must consider the program's full effect on income variability.

Utilization of a supplemental feeding strategy has been shown to be a profitable, useful managerial tool under most market conditions. However, this analysis has shown that there are many aspects of the programs that are still not completely understood. Many factors besides supplementation affect profitability; cattle prices and gains, as well as wheat price and production levels must be considered before using the program. As long as producers understand the advantages and disadvantages that come with this system, it appears to offer some very positive benefits to those producers who choose to incorporate it into their management program.

TABLE 3.1
COMPOSITION OF ENERGY SUPPLEMENTS^a

TREATMENT	HIGH STARCH	HIGH FIBER
	----- % AS-FED -----	-----
Ground Corn	78.94	----
Soybean Hulls	----	46.94
Wheat Middlings	8.90 ^b	41.74
Molasses	4.95	4.95
Calcium Carbonate	1.75	1.50
Dicalcium Phosphate	0.60	----
Micro-lite	4.15	4.15
Salt	0.65	0.65
Rumensin 60 Premix	0.07	0.07
Calculated Nutrient Content (as-fed basis)		
NEgain (Mcal/cwt)	52.80	39.30
Crude Protein (%)	8.20	11.50
Calcium (%)	0.89	0.89
Phosphorus (%)	0.44	0.53
Magnesium (%)	0.46	0.55
Monensin Content (mg/lb)	40.00	40.00

a) Fed as 3/16" pellets

b) Added to improve pellet quality (decrease fines)
of the high-starch supplement.

TABLE 3.2

EFFECT OF TYPE OF ENERGY SUPPLEMENT AND STOCKING DENSITY ON
PERFORMANCE OF STEERS GRAZING WHEAT PASTURE (1989-90)

Treatment:	Control	High Starch	High Fiber
Number of Steers ^a	48	48	48
Stocking Density (Ac/hd)	2	1.5	1.5
Supplement Consumption ^b			
Lbs/day ^c	----	4.2	4.27
% of body weight	----	0.71	0.72
Initial Weight (lb)	464	464	463
Final Weight (lb)	710	716	732
Daily Gain (115 days) (lb)	2.14	2.19	2.35
Beef gain (lb/ac)	123	168	180
Supplement Conversion ^d	----	5.95	4.88

- a) Four replications of 12 steers/treatment.
b) Control steers had free-choice access to a commercial mineral supplement.
c) Supplements were fed 96 days of the 115 day trial.
d) Pound of supplement (as-fed) per pound of increased gain per acre.

TABLE 3.3

EFFECT OF TYPE OF ENERGY SUPPLEMENT AND STOCKING DENSITY ON
PERFORMANCE OF STEERS GRAZING WHEAT PASTURE (1990-91)

Stocking Density (ac/hd)	Control			High-Starch			High-Fiber		
	2	1.64	1.38	2	1.64	1.38	2	1.64	1.38
Number of Steers	24	2	26	12	22	26	12	22	26
Number of Pastures	2	2	2	1	2	2	1	2	2
Supplement Consumption ^a lb as-fed/day ^b	0.18	0.19	0.23	3.65	3.69	3.94	3.9	4.05	4.03
% of body wt	---	---	---	0.6	0.62	0.66	0.65	0.68	0.68
Initial wt (11/21) (lb)	469	472	472	470	478	474	472	475	472
Final wt (3/8) (lb)	684	693	661	739	717	724	731	722	716
Daily Gain(107 days)	2.01	2.07	1.76	2.52	2.25	2.34	2.42	2.32	2.28
Beef Gain (lb/ac)	107	135	136	135	147	181	129	51	176
Supplement Conversion ^c	---	---	---	6.62	6.04	3.95	8.78	6.12	4.38

- a) Control steers had access to a commercial mineral supplement mix.
b) Supplements were fed 100 days of the 107 day trial.
c) Lb of supplement (as-fed) per lb of increased gain per acre.

TABLE 3.4

EFFECT OF TYPE OF ENERGY SUPPLEMENT AND STOCKING DENSITY ON
PERFORMANCE OF STEERS GRAZING WHEAT PASTURE (1991-92)

Treatment:	Control	High Starch	High Fiber
Number of Steers	24	24	24
Stocking Density (Ac/hd)	2	1.5	1.5
Supplement Consumption ^a			
Lbs/day ^b	----	2.46	3.66
% of body weight	----	0.37	0.57
Initial Weight (lb)	536	537	537
Final Weight (lb)	722	746	755
Daily Gain (84 days) (lb)	2.19	2.46	2.56
Beef gain (lb/ac)	92	138	143
Supplement Conversion ^c	----	2.4	3.31

a) Control steers had free-choice access to a commercial mineral supplement.

b) Supplements were fed 69 days of the 84 day trial.

c) Pound of supplement (as-fed) per pound of increased gain per acre.

TABLE 3.5

ENTERPRISE BUDGET FOR THE PRODUCTION OF WHEAT PASTURE
STOCKERS WITH AND WITHOUT ENERGY SUPPLEMENTATION

	UNIT	PRICE	<u>UNSUPPLEMENTED</u>		<u>SUPPLEMENTED</u>	
RECEIPTS:			QUANTITY	VALUE	QUANTITY	VALUE
Total Receipts	cwt	76.15/74.97	7.01	533.81	7.33	549.26
OPERATING INPUTS:						
Stocker Calves	cwt	83.47	4.90	409.00	4.90	409.00
Supplemental Feed	lb	0.07	0.00	0.00	333.08	23.32
Supplemental Hay	lb	0.03	200.00	6.00	200.00	6.00
Salt & Mineral	lb	0.15	26.75	4.01	0.00	0.00
Freight	cwt	0.35	7.01	2.46	7.33	2.57
Marketing	cwt	1.72	7.01	12.09	7.33	12.61
Vet-Med Expenses	hd	8.00	1.00	8.00	1.00	8.00
Mach. & Equip. Costs	hd	6.09/7.91	1.00	6.09	1.00	7.98
Interest Expense	dol	0.12	133.50	16.02	148.25	17.79
Labor	hr	5.00	1.27	6.35	2.05	10.25
Pasture Lease	acre	17.40	2.00	34.80	1.50	26.10
TOTAL OPERATING COSTS				\$504.82		\$523.62
RETURN ABOVE OPERATING COSTS (\$/hd)				\$29.02		\$25.64

TABLE 3.6

ENTERPRISE BUDGET FOR THE PRODUCTION OF
GRAZE-OUT WHEAT PASTURE STOCKERS

	UNIT	PRICE	<u>UNSUPPLEMENTED</u>		<u>SUPPLEMENTED</u>	
			QUANTITY	VALUE	QUANTITY	VALUE
RECEIPTS:						
Total Receipts	cwt	70.38/69.72	8.40	590.99	8.71	607.01
OPERATING INPUTS:						
Stocker Calves	cwt	83.47	4.90	409.00	4.90	409.00
Supplemental Feed	lb	0.07	0.00	0.00	333.08	23.32
Supplemental Hay	lb	0.03	200.00	6.00	200.00	6.00
Salt & Mineral	lb	0.15	33.25	4.99	0.00	0.00
Freight	cwt	0.35	8.40	2.94	8.71	3.05
Marketing	cwt	1.72	8.40	14.45	8.71	14.98
Vet-Med Expenses	hd	13.00	1.00	13.00	1.00	13.00
Mach. & Equip. Costs	hd	9.54/11.43	1.00	9.54	1.00	11.43
Interest Expense	dol	0.12	156.42	18.77	260.66	31.28
Labor	hr	5.00	1.98	9.90	2.76	13.80
Pasture Lease	acre	17.40	2.00	34.80	1.50	26.10
Pasture Lease-GO	acre	28.00	.50	14.00	.50	14.00
Total Operating Costs				\$546.39		\$565.96
RETURN ABOVE OPERATING COSTS (\$/hd)				\$44.60		\$41.05

TABLE 3.7
ENTERPRISE ANALYSIS NET RETURNS

	FALL/WINTER		GRAZE-OUT ¹	
	PER-HEAD	PER-ACRE	PER-HEAD	PER-ACRE
AVERAGE YEAR				
UNSUPPLEMENTED	\$29.02	\$14.51	\$15.58	\$31.16
SUPPLEMENTED	\$25.64	\$17.09	\$15.41	\$30.82
1989-90				
UNSUPPLEMENTED	\$31.15	\$15.58	\$66.53	\$133.06
SUPPLEMENTED	\$15.48	\$10.32	\$66.67	\$133.34
1990-91				
UNSUPPLEMENTED	\$43.52	\$21.76	\$19.96	\$39.32
SUPPLEMENTED	\$22.58	\$15.06	\$23.59	\$47.18
1991-92				
UNSUPPLEMENTED	(\$7.62)	(\$3.81)	\$19.75	\$39.50
SUPPLEMENTED	(\$6.34)	(\$4.23)	\$20.51	\$41.02

¹Graze-out returns reflect *additional* returns earned during the graze-out period.

TABLE 3.8
SENSITIVITY ANALYSIS OF ENTERPRISE NET RETURNS

	----FALL-WINTER----		-----GRAZE-OUT'-----	
CONTROL	PER-HEAD RETURNS	PER-ACRE RETURNS	PER-HEAD RETURNS	PER-ACRE RETURNS
LOW CATTLE	-\$3.82	-\$1.91	-1.02	-2.05
MODERATE CATTLE	\$29.02	\$14.51	15.81	31.62
HIGH CATTLE	\$59.27	\$29.63	36.68	73.37
SUPPLEMENTED				
LOW CATTLE/LOW FEED	-\$1.20	-\$0.80	-\$2.18	-4.36
LOW CATTLE/MOD. FEED	-\$7.86	-\$5.24	-\$2.18	-4.36
LOW CATTLE/HIGH FEED	-\$14.52	-\$9.68	-\$2.18	-4.36
MOD. CATTLE/LOW FEED	\$32.30	\$21.53	15.39	30.78
MOD. CATTLE/MOD. FEED	\$25.64	\$17.09	15.39	30.78
MOD. CATTLE/HIGH FEED	\$18.98	\$12.65	15.39	30.78
HIGH CATTLE/LOW FEED	\$63.75	\$42.50	36.35	72.70
HIGH CATTLE/MOD. FEED	\$57.09	\$38.06	36.35	72.70
HIGH CATTLE/HIGH FEED	\$50.42	\$33.61	36.35	72.70

'Graze-out returns reflect additional returns earned during the graze-out period.

TABLE 3.9

WHOLE-FARM NET RETURNS UNDER THREE MANAGEMENT OPTIONS
WITHOUT ENERGY SUPPLEMENTATION, 1000 ACRES

	NON-PART	REGULAR	0/92
Acres Harvested	750	750	750
No. of Head-Fall/Winter	500	500	500
No. of Head-Graze-out	490	490	490
REVENUE:			
Deficiency Payment	0	\$26,250	\$25,760
Wheat	\$34,583	\$34,583	\$34,583
Stocker(Fall/Winter)	\$266,905	\$266,905	\$266,905
Stocker(Graze-out)	\$27,998	\$28,018	\$28,018
TOTAL REVENUE	\$329,506	\$355,756	\$355,266
OPERATING COST:			
Wheat (Harvested)	\$58,680	\$58,680	\$58,680
Wheat (Non-Harvested)	\$12,060	\$12,060	\$12,060
Stocker(Fall/Winter)	\$235,010	\$235,010	\$235,010
Stocker(Graze-out)	\$13,509	\$13,509	\$13,509
TOTAL COSTS	\$319,259	\$319,259	\$319,259
NET RETURN	\$10,246	\$36,496	\$36,006

TABLE 3.10

WHOLE-FARM NET RETURNS UNDER THREE MANAGEMENT OPTIONS
WITH ENERGY SUPPLEMENTATION, 1000 ACRES

	NON-PART	REGULAR	0/92
Acres Harvested	666	700	666
No. of Head-Fall/Winter	667	667	667
No. of Head-Graze-out	654	600	654
REVENUE:			
Deficiency Payment	0	\$24,500	\$25,760
Wheat	\$30,709	\$32,277	\$30,709
Stocker(Fall/Winter)	\$366,356	\$366,356	\$366,356
Stocker(Graze-out)	\$37,769	\$34,650	\$37,769
TOTAL REVENUE	\$434,834	\$457,783	\$460,594
COSTS:			
Wheat (Harvested)	\$52,108	\$54,768	\$52,108
Wheat (Non-Harvested)	\$16,112	\$14,472	\$16,112
Stocker(Fall/Winter)	\$326,043	\$326,043	\$326,043
Stocker (Graze-Out)	\$18,528	\$16,998	\$18,528
TOTAL COSTS	\$412,791	\$412,281	\$412,791
NET RETURN	\$22,043	\$45,502	\$47,803

TABLE 3.11

WHOLE-FARM NET RETURNS UNDER 30 BUSHEL WHEAT YIELDS
WITHOUT ENERGY SUPPLEMENTATION, 1000 ACRES

	NON-PART	REGULAR	0/92
Acres Harvested	750	800	644
No. of Head-Fall/Winter	500	500	500
No. of Head-Graze-out	490	400	490
FINAL NET RETURN			
REVENUE:			
Deficiency Payment	0	\$28,000	\$25,760
Wheat	\$65,250	\$69,600	\$65,250
Stocker(Fall/Winter)	\$266,905	\$266,905	\$266,905
Stocker(Graze-out)	\$28,018	\$22,872	\$28,018
TOTAL REVENUE	\$360,173	\$387,377	\$385,933
COSTS:			
Wheat (Harvested)	\$58,680	\$62,592	\$58,680
Wheat (Non-Harvested)	\$12,060	\$9,648	\$12,060
Stocker(Fall/Winter)	\$235,010	\$235,010	\$235,010
Stocker (Graze-Out)	\$13,509	\$11,028	\$13,509
TOTAL COSTS	\$319,259	\$318,278	\$319,259
NET RETURN	\$40,914	\$69,099	\$66,674

TABLE 3.12

WHOLE-FARM NET RETURNS UNDER 30 BUSHEL
WHEAT YIELDS WITH ENERGY SUPPLEMENTATION

	NON-PART	REGULAR	0/92
Acres Harvested	666	800	644
No. of Head-Fall/Winter	667	667	667
No. of Head-Graze-out	654	400	654
FINAL NET RETURN			
REVENUE:			
Deficiency Payment	0	\$28,000	\$25,760
Wheat	\$57,942	\$69,600	\$57,942
Stocker(Fall/Winter)	\$366,356	\$366,356	\$366,356
Stocker(Graze-out)	\$37,769	\$23,100	\$37,769
TOTAL REVENUE	\$462,067	\$487,056	\$487,827
COSTS:			
Wheat (Harvested)	\$52,108	\$62,592	\$52,108
Wheat (Non-Harvested)	\$16,112	\$9,648	\$16,112
Stocker (Fall/Winter)	\$326,043	\$326,043	\$326,043
Stocker(Graze-out)	\$18,528	\$11,332	\$18,528
TOTAL COSTS	\$412,791	\$409,615	\$412,791
NET RETURN	\$49,276	\$77,441	\$75,036

TABLE 3.13
SENSITIVITY ANALYSIS OF WHOLE-FARM NET RETURNS

CONTROL	-----WHOLE-FARM-----		
	NON-PART OPTION	5-MONTH OPTION	"0/92" OPTION
LOW CATTLE	\$16,359	\$46,042	\$42,119
MODERATE CATTLE	\$40,914	\$69,099	\$66,674
HIGH CATTLE	\$66,382	\$92,671	\$92,142
SUPPLEMENTED			
LOW CATTLE/LOW FEED	\$10,986	\$43,619	\$45,630
LOW CATTLE/MOD. FEED	\$15,428	\$48,061	\$41,188
LOW CATTLE/HIGH FEED	\$19,870	\$52,503	\$36,746
MOD. CATTLE/LOW FEED	\$44,834	\$72,999	\$79,478
MOD. CATTLE/MOD. FEED	\$49,276	\$77,441	\$75,036
MOD. CATTLE/HIGH FEED	\$53,718	\$81,883	\$70,594
HIGH CATTLE/LOW FEED	\$79,493	\$102,344	\$114,137
HIGH CATTLE/MOD. FEED	\$83,935	\$107,655	\$109,695
HIGH CATTLE/HIGH FEED	\$88,377	\$111,228	\$105,253

CHAPTER IV

ECONOMIC EVALUATION OF WHEAT VARIETIES BASED ON GRAIN AND FORAGE PRODUCTION

Grain producing ability has long been the single most important factor considered by Oklahoma wheat producers in choosing a variety to plant. Producers' variety selection decisions were based almost exclusively upon this criteria, with forage production potential essentially being ignored. During times of relatively high wheat prices and low cattle prices, the importance of income from grazing cattle was not of major concern to most producers.

Today, producers recognize the value and importance of grazing cattle on wheat. Wheat varieties are now evaluated not only on their grain producing ability, but also their ability to produce forage for grazing during the fall, winter, and possibly, spring seasons. In 1991, approximately 7 million acres of wheat were planted in Oklahoma (Oklahoma Ag. Stat., 1992). It has been estimated that approximately 50 percent of planted acres are grazed to some extent (Harwell, 1974). Government program payments can comprise a very significant share of farm income and influence variety selection. Program provisions often permit the grazing of set-aside acres, while still receiving a deficiency payment.

This feature should increase awareness of the forage producing potential of different wheat varieties.

Wheat varieties that offer improved grain and/or forage producing abilities are constantly being introduced. These new varieties frequently out perform older, established varieties. In a 1988 survey of Oklahoma wheat pasture utilization systems (Walker et al., 1988), it was found that producers typically plant at least two varieties, and base variety selection on expected utilization of the wheat for grazing purposes. Two of the most popular varieties at that time were Chisholm and Pioneer 2157. Producers cited the capability of these two varieties to produce large quantities of forage, as well as adequate grain yields as reasons for their utilization (Walker et al., 1988).

The recognition of the importance of forage production should lead to the development of more high forage producing varieties that can consistently maintain high grain yields. Many different varieties that offer a multitude of physical characteristics are currently available to producers. Each producer will find some characteristics of a variety that are appealing, and others that are not. Performance of varieties will also differ across geographical locations, and are affected by weather and climatic conditions. The variation in climatic conditions between years encourages many producers to plant more than one variety in an attempt to decrease production risk. Finding a variety that consistently meets one's production goals is a constant and on-going process.

Grain yield and forage production performance data has long been used to evaluate the merit of different varieties. Ranking varieties based on this data is useful in that it is simple and top performing varieties are easily identified. The problem with such an approach is that not all of the important aspects of the production system are included in the evaluation. Basing variety selection on grain or forage yield performance is appropriate only if wheat is being grown exclusively for that purpose. Picking the highest grain yielding variety or the highest forage producing variety might not provide producers with the highest income if they wish to both graze and harvest grain. Grain yield and forage production data must be combined and expressed in terms of a single numerare - dollars of income. Wheat price, livestock prices and production levels, weather, and geographical differences must all be taken into consideration when choosing a wheat variety. These items all play important roles in the overall profitability of the wheat-stocker production system.

The objective of this study is to develop a more comprehensive procedure for evaluating current and future wheat varieties based upon their profit potential. The effects of wheat and livestock prices on the economic performance of different varieties is also evaluated.

Procedures

Forage and grain production data were collected for all varieties grown at six different locations across three

growing seasons (1989-90, 90-91, 91-92). Forage production includes both the fall and winter periods until early joint stages. The evaluation of the same twelve varieties across six locations and over three complete growing seasons should provide a good indication of the performance capabilities of each. Table 4.1 provides a list of the varieties evaluated. Table 4.2 lists the location and production season of each trial.

Enterprise budgeting procedures are used to evaluate twelve winter wheat varieties based upon their grain and forage producing characteristics. Total net returns are estimated as the sum of returns earned from the wheat enterprise and a stocker enterprise grazing available forage. Net returns from the combined wheat and livestock enterprises are estimated on a per-acre basis, and the varieties are ranked accordingly.

Actual wheat production costs from each location are used in conjunction with a standardized stocker budget. The stocker budget has been developed to represent an average production and price scenario during the three production seasons (Table 4.3). Forage and grain yields for each of the varieties at each location are used to develop enterprise budgets. A return above operating cost (\$/acre) is estimated for each variety of wheat at each location and year. This return is then added to the returns generated from the stocker enterprise to create a net return from the joint production of wheat and fall-winter grazing.

Determining the return above operating cost for the wheat enterprise is straightforward. Grain yield (bu/ac) is multiplied by the price of wheat to calculate total revenue for wheat. This price reflects the average price received by Oklahoma producers. Total production costs are subtracted from total revenue to determine the per-acre return above operating cost.

Two different methods are used to estimate per-acre net returns from the stocker enterprise. Both methods use the same production data and budgets, but differ in terms of the procedures used to allocate forage production to the stocker enterprise.

Method I

The base stocker budget (Table 4.3) is calculated on a per-head basis and assumes steers are grazed 115 days at an average daily gain of 2 pounds. To calculate stocker returns on a per-acre basis, the per-head net returns are divided by the stocking density (e.g., \$62.14/head returns with a stocking density of 2 acres/head yields a per-acre return of \$31.07/acre). The stocking density is a function of forage production, animal forage utilization and performance, and days pastured, and will differ across locations.

Stocking density (head/acre) is calculated as:

$$SD = \frac{REQ * DAYS}{FP}$$

where:

REQ = Dry matter forage requirement (lbs/day).
DAYS = The number of days cattle are grazed on wheat
 pasture.
FP = Fall/winter forage production (lbs/year).

Stocking density is a variable in this procedure. Stocking density is not set at any particular level, but is determined by the pounds of forage produced. Per-acre returns will be greater for the high forage producing varieties because theoretically, more cattle can be grazed.

To calculate per-acre returns, it is assumed that steers are stocked at rates which would utilize all forage produced from planting until jointing. Using this procedure, all forage production is utilized in the 115 day grazing period. This procedure will cause the stocking density to vary substantially. Therefore, stocking density will be the major factor affecting per-acre returns from the stocker cattle enterprise.

Determining the quantity of forage necessary to produce a pound of gain in steers is a difficult task. For lack of a definitive number, two forage conversion factors are used in this analysis. The first factor is calculated based upon National Research Council(NRC) energy requirement and intake estimation procedures. This quantity is considered on the low end of the possible forage allocations. The second factor is the result of current research being conducted at Oklahoma State University and is reflective of the high end of forage requirements.

The NRC method yields a forage requirement of 14 pounds

of dry matter wheat forage to produce 2 pounds of gain in steers having an average feeding weight of approximately 565 pounds. This estimate is based on wheat pasture with an NE_m value of 74.10 Mcal/kg and an NE_g value of 46.80 Mcal/kg. To estimate the forage to gain factor, daily dry matter feed intake is set at 2.5% of mean feeding weight (565 pounds), or 14.2 pounds/day. Using these values, the feed to gain ratio is 7:1; that is, 7 pounds of dry matter are required to produce a pound of gain.

This allocation assumes 100 percent harvest efficiency, and makes no allowances for non-consumptive uses. Non-consumptive forage includes the forage that cannot be grazed by the animal. This forage has either been trampled, or it is too close to the ground to be of any use to the animal. However, the clipping procedure used to estimate forage production does not harvest all forage present. An estimated 500-750 pounds of standing crop remains unharvested at each clipping. It is assumed that this amount is sufficient to cover non-consumptive uses and still provide sufficient standing forage to assure proper grazing management.

The second conversion factor, which is based on current OSU experimental data, yields a forage requirement of 24 pounds of forage for each two pounds of gain. This method requires that in addition to the 14 pounds of forage estimated from the NRC intake calculation, additional forage must be available for non-consumptive uses during the grazing period.

This factor is based upon a forage availability study

conducted by Horn et al.(1992). The experiment was designed to determine the pounds of forage per steer day necessary to produce a pound of gain in steers. Forage production estimates used were gathered by hand clipping of sites, whereas the production estimates reported in Table 4.4 were mechanically clipped. Because 500-750 pounds of forage remains after the mechanical clipping procedure, the hand clipped estimates were decreased 500 pounds to correspond with the mechanically clipped data. Regression estimates indicated that an additional 10 pounds of forage are necessary to maintain 2 pounds of gain per day, bringing total daily consumption to 24 pounds/day (i.e. 14 lbs (NRC) + 10 lbs = 24 lbs).

This allocation does not assume 100% forage efficiency, and requires forage in excess of intake in order to maintain an ADG of 2.0. Non-consumptive uses are accounted for by the additional 10 pounds of forage. The 24 pound factor is considered to be representative of the high end of the possible forage allocation values.

Method II

Method II differs from method I in terms of the manner that forage is allocated to the livestock. Stocking density is now set at a constant 2 acres per-head, and net returns are calculated based on this constant stocking density. Forage is then valued based upon the cost of supplemental feed needed to meet forage deficits and/or additional grazing days available

from forage surpluses. Method I assumes perfect information; that is, total forage production is known prior to grazing, and, stocking density is set at a level which will completely utilize all forage production. Such an approach does not address the intra-seasonal dynamics of the forage allocation problem. Over the course of a grazing season, most producers do not have the luxury of changing stocking density without selling cattle at a loss or decreasing the gain of all cattle. Method II portrays a more realistic situation by tracking forage availability throughout the grazing season. The value of the wheat variety for grazing is based upon the factor most critical to most producers - the ability to avoid situations of limited forage and having to provide supplemental feed.

As compared to Method I, Method II requires considerably more forage production data. Ideally, to track forage availability through the grazing season requires several clipping dates. On three of the nine sites, forage was clipped three times, twice during the winter and at jointing. From this clipping data and the planting date, forage production levels were interpolated from planting until jointing. This data was used to determine the quantity of forage available from planting until jointing. Average and cumulative production were estimated by week.

Stockers were assumed purchased on October 15. Once cumulative forage production reached the level necessary to supply sufficient forage for one week, the cattle were placed on the pasture. Animals were assumed to remain on pasture as

long as there was adequate forage available for one week. During any time forage stocks were in a deficit situation, steers were not allowed to graze until forage stocks were sufficient to supply enough forage for one week. If forage stocks were not sufficient, cattle were fed a maintenance ration to maintain weight until adequate forage stocks were available.

Forage intake was calculated using the NRC intake equation:

Daily Feed Intake (kg DM) =

$$W^{0.75} (.1493NE_m - 0.0460NE_m^2 - 0.0196)$$

where:

W = body weight (kilograms).

NE_m = net energy for maintenance (Mcal/kg).

At jointing, which is traditionally the approximate pull-off date, the amount of forage remaining and/or the number of days that livestock had to be fed the maintenance ration are determined. If livestock were fed at any time during the season, the number of days fed are multiplied by the average daily gain under grazing to determine the total reduction in seasonal gain. This value is then subtracted from the gain when forage is available throughout the grazing season to determine net return.

If forage remained at the end of the fall/winter period, it is assumed that this forage will be utilized during the graze-out season and will contribute extra grazing days. The procedure for calculating the number of extra grazing days is as follows:

$$\text{Extra Grazing Days} = \frac{\text{Pounds of Forage Remaining} * .25}{18.0 \text{ Pounds of DM Forage/Day}}$$

The pounds of forage remaining is determined by the production levels of each variety and livestock consumption, and will differ by variety and year. A conversion factor of .25 is used because stocking density is increased from 2 acres/head to 0.5 acres/head from fall/winter grazing to graze-out grazing. Therefore, only 25 percent of the acres grazed during fall/winter will be grazed during the graze-out season. Graze-out intake is again determined by the NRC intake equation (eq.1) and equals 18.0 pounds of dry matter forage per day. This intake is based on an average steer weight during the graze-out phase of 760 pounds. If extra grazing days are available, the value of gain during graze-out is multiplied by the extra days, and this value is added to the base situation net return.

Method I intake levels are based on NRC estimates, in which 14 to 24 pounds of forage will produce 2 pounds of gain per day. In average to high forage production years, this procedure generates stocking densities that are exceedingly high, and few producers would ever stock pastures at these rates. Average stocking density is 1.11 acres/head for the 14 pound allocation, and 1.90 acres/head under the 24 pound allocation. There is also no penalty for low forage yields stocking densities are simply adjusted to utilize all forage production in the 115 grazing days. Forage is essentially

considered a stock resource in that seasonal forage production can be utilized at any time. In actuality, there is a possibility that forage deficits can arise through the grazing season, even though total annual forage production is sufficient to cover animal requirements.

Method II treats forage as a flow resource and tries to account for the timing of forage production. This procedure requires that animals be fed during times of inadequate forage, and impose a penalty on net returns when forage is inadequate. Method II may generate more realistic net return estimates in that it recognizes the probabilities of inadequate forage levels and the possible need for supplemental feeding. Method II also recognizes that forage may be in a surplus situation and can be utilized at other times.

Data

Grain and Forage Production Data

Tables 4.4 and 4.5 contain the actual grain yields and forage production levels for each variety at each evaluation site. Production levels are reported on a per-acre basis and the ranking of each variety by site is included to the right of each value. Wheat yields ranged from 9.2 to 59.7 bushels/acre with an average of 30 bushels/acre. Forage production levels ranged from 46 to 3,328 pounds of dry matter forage/acre, with an overall average of 1,452 pounds/acre.

Average production levels by variety are reported in the right column of each table. Average grain yields range between 25.3 and 33.4 bu/acre, and forage yields range between 974 and 1802 lb/acre. Pioneer 2180 has the highest average forage production, but ranks tenth in terms of grain yield. On the other hand, Karl and Arapahoe provide the highest average grain yield, but rank fourth and eleventh, respectively, in forage production.

At the bottom of each column the average, minimum, maximum, and standard deviation has been calculated for each of the evaluation sites. Average grain production was highest at Chickasha in 1990-91 with an average of 52.2 bushels/acre, and lowest at Marshall 1990-91 with a per-acre average of 13.8 bushels. The highest average forage production was also from Chickasha in 1990-91 at 2,450 pounds/acre, while the lowest was at Fredrick 1991-92 with an average of only 367 pounds/acre. Clearly, considerable variability in both grain yields and forage production exists across varieties and sites.

Wheat Production Budgets

Evaluation sites are a mix of producer-cooperators and experiment stations. A fairly wide range of production situations have been included in an attempt to capture the diverse operating conditions across the state. Therefore, managerial practices and production cost information differ

across sites. Appendix A contains the specific operating cost information for each of the locations. Production practices used were primarily designed to maximize per-acre returns from the combination of forage and grain.

The trials conducted in Marshall during the 1989-90 and 1990-91 seasons incurred the same operating expenses (\$78.24/acre). Fertilizer expenses were the most significant expense at \$27.62/acre.

The trial with the lowest total operating cost was conducted at Buffalo during the 1989-90 season. Total operating costs for this trial were \$65.15/acre. Anhydrous ammonia was applied at a cost of \$9.02 per acre. Machinery and equipment costs were the largest expense, costing \$25.25 per acre.

Total operating costs were highest for the trial conducted at Purcell during the 1989-90 growing season. Total operating costs for this trial were \$118.25/acre, and included a fertilizer expense of \$29.25/acre, herbicide and insecticide costs of \$24.30/acre, labor costs of \$18.10/acre, and machinery costs totaling \$33.00/acre.

Trials conducted during the 1990-91 growing seasons include Chickasha, Fredrick, and Marshall. Total operating costs at Chickasha were \$86.20/acre. Fertilizer expense was approximately 42 percent of the total cost, or \$36.08/acre. Total operating costs at Fredrick were \$95.35/acre, including fertilizer costs of \$45.23/acre and machinery and labor costs of \$35.36/acre.

Trials conducted during the 1991-92 seasons were located at Fredrick, Haskell, and Marshall. Total operating expenses at Fredrick were \$68.72 per acre. The largest expense was machinery and equipment costs, followed by labor and fertilizer expenses. Total expenses at Haskell and Marshall were \$88.81/acre, and \$66.20/acre, respectively.

Total operating costs range from \$65.15 to \$118.25 per acre across test sites. Again, the total operating costs are subtracted from total revenue to determine the return for the wheat varieties. Revenue is calculated based on a wheat price of \$3.00/bushel, the average wheat price received by Oklahoma producers in the three-year period (Oklahoma Agri. Stat., 1992).

Stocker Budget

In order to fairly and accurately determine the value of each varieties production, a representative stocker budget was developed (see Table 4.3). This budget reflects an average price situation over the three year period, and is applied to all sites. Purchase and selling prices represent the three year average price at the Oklahoma City National Stockyards of No. 1 medium frame steer calves purchased in November and sold in March. Steer calves are purchased weighing 450 pounds at a cost of \$104.22/cwt. The selling price for steers weighing approximately 680 pounds is \$88.46/cwt. A one percent death loss is assumed.

Operating inputs and cost include a \$6.00 per head charge

for supplemental hay. Hay is fed during receiving and for snow cover days, and is valued at \$60/ton. Salt and mineral are fed at a rate of .15 lb/day over the entire grazing period, with an estimated cost of \$4.31/head. Freight and marketing charges are \$.35/cwt and \$1.72/cwt, respectively. Vet and medical charges are \$8.00 per head and included vaccinations, worming, implants, and eartags. Estimates for machinery and equipment expenses as well as labor requirements are taken from the OSU Enterprise Budget Generator. Machinery and equipment charges are \$6.09 per head, and labor requirements are 1.27 hours per head. Labor is valued at \$5.00 per hour. Interest expense is calculated at \$20.67 per head using an annual percentage rate of 12 percent.

Total receipts for the representative stocker enterprise are \$595.51 per head. Total costs are \$533.37 per head which includes \$468.99 for the purchase price of the calf and \$64.38 in operating costs. The return above operating cost is \$62.14 per head.

Results

Net returns (\$/acre) from the combined grazing enterprise are calculated under the three alternative forage allocation methods. Net returns and rankings for each variety at each location are provided in Table 4.6 for Method I (14 pound forage requirement, Table 4.7 for Method I (24 pound forage requirement, and Table 4.8 for Method II. Rankings are reported in parentheses to the right of the net return.

Average values are calculated for each variety and an average rank is assigned in the right-hand column. At the bottom of each table, the average, minimum, maximum, and standard deviation of per-acre net returns are reported for each site.

Method I - 14 Pound Forage Requirement

Three evaluation sites were used in the 1989-90 production year (Buffalo, Marshall, and Purcell). Net returns at Buffalo ranged from a low of \$25.01/acre (TAMW-101) to a high of \$51.07/acre (TAM 200). Karl ranked first at Marshall with a return of \$64.68/acre, while Sierra was twelfth with a per-acre return of \$10.66. Returns at Purcell ranged from - \$14.27/acre for Chisholm to \$44.47/acre for Pioneer 2180.

All three production sites used in 1989-90 were similar in terms of grain and forage yields, as well as net returns. Purcell produced the highest average grain yield and forage production; however, Purcell also had the highest production costs, resulting in net return levels below the other two locations. Buffalo produced the highest average net return and was characterized by the least amount of variability in net returns across varieties. Karl was the only variety that ranked in the top six at all three sites.

Evaluation sites for 1990-91 were Chickasha, Fredrick, and Marshall. Forage and grain production levels at Chickasha and Fredrick were the highest of the nine sites used in the study. At Chickasha, the highest return was achieved by Karl (\$196.46/acre). Arapahoe provided the lowest net return;

however, net returns were still relatively high at \$146.14/acre. Both forage and grain production were extremely high during this particular year, as is evident by the calculated returns. Net returns at Fredrick were also high relative to the other sites. TAM 200 had the largest return of \$145.75/acre, while Mesa was the lowest with a return of \$78.11/acre.

Returns at Marshall were significantly lower than either Chickasha or Fredrick, reflecting both low grain and low forage yields. While grain yields averaged 52.2 bushels/acre at Chickasha and 42.1 bushels/acre at Fredrick, yields at Marshall only averaged 13.8 bushels/acre. Average forage production at both Chickasha and Fredrick exceeded 2,400 pounds/acre, while Marshall only averaged slightly over 1,000 pounds/acre. As a result, net returns at Marshall averaged only \$2.63 per acre and ranged from -\$29.17/acre for Sierra to \$29.75/acre for Thunderbird. Thunderbird performed well during the 1990-91 season ranking in the top five at all three sites.

Sites for the 1991-92 production year were Haskell, Marshall, and Fredrick. Marshall and Fredrick were also sites in the previous season; however, variety performance is not consistent across the two years. Due to improved grain yields, net returns at Marshall were somewhat higher than the two previous production years. As in the 1989-90 production year, Karl produced the highest return, \$105.86/acre. Pioneer 2157 produced the lowest net return level of \$44.77/acre.

Returns at Fredrick ranged from \$20.21/acre to \$104.39/acre. Ranking first was Sierra, followed by AGSECO 7846 and TAM 200. The most significant difference between 1990-91 and 1991-92 at Fredrick was the forage production levels. Average forage production decreased from 2,434 pounds in 1990-91 to only 367 pounds in 1991-92. As a result, projected stocker returns were dramatically lower for the 1991-92 season, and net return rankings primarily reflect grain production. At Haskell, Karl ranked first with a return of \$92.09/acre, and Abilene ranked last with a return of \$5.41/acre.

An interesting comparison can be made between results from Haskell and Fredrick during the 1991-92 season. As shown in Tables 4.4 and 4.5, Haskell produced the highest average forage levels and the lowest average grain levels, while Fredrick produced the opposite, the highest grain yields and lowest forage levels. When expressed in terms of net returns, the better grain producing varieties ranked highest at Fredrick, while net return rankings at Haskell were dictated by forage production. Production levels at Marshall tended to lie between those at Haskell and Fredrick, and net return levels were generally higher and less variable.

As is evident using the 14 pound allocation method, the variation in net returns and rankings can be substantial from year to year and across locations. However, the majority of net returns are positive. Negative net returns only occurred at two sites: Marshall (1990-91) and Purcell (1989-90). Marshall's negative returns were caused by poor grain yields,

while Purcell's were attributable to high wheat production costs.

Average net returns over the nine sites are presented in Figure 4.1. Karl ranked first at 4 of the 9 locations, and clearly produced the highest average net returns of the locations analyzed. Average returns from Karl exceeded the average from all twelve varieties by \$17.06. Pioneer 2180 ranked second in terms of average net returns (\$68.30 per acre) followed by Thunderbird (\$67.25) and Agseco 7846 (\$63.54). Little difference in average net returns occurred among the next four varieties; in fact only \$1.41 per acre separated the fifth ranked variety from the eighth ranked variety. Varieties comprising the lower third group consistently ranked in the lower half across sites.

The 14 pound allocation method results in a situation where livestock returns are the major factor influencing total net returns. Grain yields were not sufficient to cover wheat operating cost at 4 of the 9 locations. Stocker returns accounted for 89% of the total returns generated from each variety, while grain revenue, on the average, contributed only 11% of the combined returns.

Method I - 24 Pound Forage Requirement

Results from applying the 24 pounds per day allocation are similar to the 14 pound results. Varieties tend to shift in ranking by one or two places, however, seldom did the ranking change more than three places. As expected, net return levels

decreased using this method as compared to the 14 pound allocation. While wheat returns are constant, livestock returns would be expected to decrease because stocking densities are lower. More forage is required to be allocated to each animal. The number of occurrences of a negative return is increased; however, the majority of net returns remain positive. In general, the higher grain producing varieties tended to improve in ranking when using the larger allocation; however, forage production is still an important component of total net returns.

Results at Buffalo (1989-90) show that Arapahoe produced the largest return, and TAM W-101 produced the smallest, \$37.75/acre and \$8.82/acre, respectively. Varieties earning the highest net returns at Marshall (1989-90) are Karl, (\$39.75/acre), followed by Abilene (\$37.29/acre) and Thunderbird (\$28.99/acre). The highest ranking variety at Purcell (1989-90) was again Pioneer 2180 (\$13.04/acre), and the lowest was again Chisholm (-\$33.34).

Although net returns decreased relative to the 14 pound method, the ranking of varieties did not change dramatically. Karl again ranked in the top 4 at all three sites, while Thunderbird and Arapahoe also performed well.

The 1990-91 results at Chickasha indicate that Karl, Abilene, and Agseco 7846 provided the highest returns, with returns of \$151.81, \$144.44 and \$136.64/acre, respectively. At Marshall, Thunderbird (\$4.63/acre), Abilene (-\$3.51/acre), and Karl (-\$9.26/acre) generated the highest net returns. TAM

200 yielded the highest net return at Fredrick(1990-91) with returns of \$100.80/acre; however, Arapahoe (\$94.54/acre) and Agseco 7846 (\$93.29/acre) produced similar net returns.

The low grain production levels at Marshall are mainly responsible for the negative return levels. Stocker returns were not sufficient to maintain positive total net returns, as under the 14 pound allocation. Average net return levels dropped 24% at Chickasha, 626% at Marshall, and 33% at Fredrick. Again, this is due to the lower stocking densities associated with the 24 pound forage allocation.

In 1991-92, Karl ranked first at both Haskell and Marshall, but is 10th at Fredrick. Haskell returns ranged from -\$19.60 for Abilene to \$52.09 for Karl. Pioneer 2180 and Thunderbird ranked second and third with returns of \$18.14/acre and \$10.53/acre, respectively. The 1991-92 returns at Marshall were the highest of the three years evaluated. Karl produced \$86.17/acre, Abilene ranked second at \$78.50/acre, and Arapahoe was third at \$78.34/acre. Pioneer 2157 was the poorest performing variety at Marshall, producing a net return of \$21.16/acre. Results at Fredrick (1991-92) were almost completely opposite of all prior results. Sierra, which has consistently produced low returns, ranked first (\$106.97/acre). Sierra was the highest grain producing variety at the site, but ranked 11th in forage production. However, forage production was so poor for all varieties that grain yields primarily determined net returns. Thunderbird, which had consistently performed well, ranked

last with returns of \$23.10/acre. Thunderbird had the lowest grain yield and was well below average in forage production levels.

No variety ranked in the top six at all three sites during the 1991-92 season. Karl ranks first at Haskell and Marshall but falls to tenth at Fredrick. Thunderbird is third at Haskell, fourth at Marshall, and twelfth at Fredrick.

Although in most cases the overall ranking of varieties did not significantly change as a result of the larger forage allotment, the net return levels did. In moving from an allotment of 14 to 24 pounds of forage per day, more weight is placed on the grain production of each variety. Under the 14 pound allocation, forage production is obviously the critical variable in determining economic returns. With the 24 pound allocation, both grain and forage production may influence the economic ranking. Livestock returns still dominate grain returns; on the average, stockers contributed 83% of the combined returns while grain contributed 17%.

Average net returns over the nine sites are presented in Figure 4.2. As under the 14 pound allotment, Karl clearly outperformed the other varieties in terms of average net returns. Little difference in average and net returns separates the next five varieties. In fact, average net returns only decrease \$2.73 per acre in moving from the second to sixth ranked variety. Little difference in average returns occurs across the final six varieties, as well.

Method II

The net returns and rankings produced using Method II are reported in Table 4.8. Only three sites were analyzed using Method II because these were the only sites with adequate forage clipping data.

Results from Purcell (1989-90) indicate that Pioneer 2180 performed best, generating \$11.32/acre. Karl generated \$3.46/acre, while Thunderbird ranked third producing \$3.19/acre. The average net return at Purcell was -\$16.05, and 9 of the 12 varieties generated negative net returns. A large reason for the negative returns is that production costs are \$118.25/acre, and grain yields only average slightly over 25 bushels/acre. Forage production levels were adequate so that only four of the varieties were penalized for low forage yields. In these cases, the timing of growth was a more significant problem than lack of forage.

Chickasha (1990-91) produced significantly higher returns than either Purcell or Marshall, reflecting high grain and forage yields. Forage production levels were high enough that additional forage remained for the graze-out period and an average of 33 extra grazing days were available. Variation in net returns across varieties was much lower using this forage allocation method, ranging from \$113.92 (TAM 200) to \$155.17/acre (Karl). Karl ranked second in forage production and third in grain production, while TAM 200 ranked seventh in forage and eleventh in grain production. Grain revenue made

up 53% of total net returns while stockers contributed 47%.

Marshall 1990-91 net returns are the lowest on average, and show the largest degree of variability among the three sites. Net returns range from $-\$148.33/\text{acre}$ for Sierra to only $\$6.04/\text{acre}$ for Thunderbird. Eleven of the twelve varieties at Marshall produced negative net returns. In contrast, Thunderbird produced 5.84 extra grazing days, while Sierra produced only 35 days of grazing throughout the year. Grain production is the lowest of all sites; therefore, forage production becomes the most important consideration. The average loss in the grain enterprise was $\$36.84/\text{acre}$. Nine of the twelve varieties had deficit forage levels at some time throughout the season, necessitating the use of supplemental feed.

The rankings generated by Method II are similar to those provided by Method I. For example, both methods identify the same first and second ranked varieties in each of the three sites. Some isolated incidents occur where a variety's ranking drops significantly under Method II. In each of these cases, forage production was limiting over a significant period of the grazing season, resulting in significant reductions in livestock returns.

As under Method I, varietal performance is not consistent across locations. For example, Karl has the highest average return, but ranks first, second, and fourth across the three locations. Conversely, Sierra has the lowest average net return but still ranks third at Chickasha (1990-91). While

net return ranks are useful for determining relative profitability, one must also consider the magnitude of the difference in net returns between varieties. For example, the difference in returns between the third and fourth ranked varieties at Chickasha is \$0.11 per acre.

The most important difference between Methods I and II is that adequate forage must be available at all times for returns from livestock grazing to be maximized. Varieties are judged not only on total forage production, but also the timing of its production. Therefore, while a variety might perform well under Method I it might perform poorly using Method II. An illustration of this situation is the variety Abilene in the 1990-91 production season at Marshall. Forage production was 927 pounds/acre (rank=9) and grain yield was 17.9 bushels/acre (rank =1). Under Method I - 14 pounds Abilene generated returns of \$11.51/acre. Using the 24 pound allocation of Method I net returns fall to a loss of \$3.51/acre. However, using the Method II, Abilene produces a loss of \$33.81/acre. Under method I cattle are stocked to utilize all production in 115 days. Under the 14 pound allocation, cattle are stocked at 1.74 acres/head; while under the 24 pound allocation, a stocking density of 2.97 acres/head occurs. When stocked at a constant 2 acres/head under Method II, cattle must be fed for 35 days, and a loss of \$40.34/acre is produced by the stockers.

Price Sensitivity Analysis

An important question concerning variety selection is how changes in wheat and cattle price affect variety net returns and rankings. The results reported above are for the median price situation. To determine these effects, wheat and stocker prices were adjusted to create different price structures. A situation where wheat price is low and cattle prices are high is evaluated, as is the situation where wheat price is high and cattle prices are low. Net returns are estimated using both of these price scenarios, and the twelve varieties are again ranked based upon their net return.

To create the alternative price structures, the ten year average selling prices of both wheat and stocker cattle were calculated in real terms(1991 dollars). These prices were then divided into the three highest, three lowest, and the remaining four were considered the median price situation. The average of the low, median, and high prices are used to create the alternative price structures. This procedure allows for the profit potential of each variety to be assessed under the low, median, and high price scenarios of the last ten years. Wheat prices are \$2.50, \$3.00, and \$3.50 for each of the price situations. Steer selling prices reflect a value of gain of \$44.00/cwt for the low cattle, \$57.63/cwt for the median situation, and \$72.00/cwt for the high cattle scenario.

Net return levels were estimated for the twelve varieties using the 24 pound forage allocation under "low wheat - high

cattle" (LW - HC) and "high wheat - low cattle" (HW - LC) price scenarios. Results are presented graphically for three varieties, reflecting changes in the net return ranking observed in each of the nine sites. Rankings under alternative price scenarios are presented for Pioneer 2157, Chisolm, and Arapahoe. Pioneer 2157 was chosen because it is one of the highest forage producers and the lowest grain producer. Arapahoe is generally one of the low forage producers and one of the high grain producers, while Chisholm has median levels of production for both grain and forage. These three varieties should provide a good indication of how the different price structures affect varieties which have opposite production characteristics.

The effects of the alternative price structures on the relative profitability of Arapahoe are shown in Figure 4.3. The rank under each price situation at all nine locations is included. In general, the net return rank is shown to be very sensitive to the price scenario. Arapahoe ranks second in grain production and eleventh in forage production. Because Arapahoe ranks higher in grain production than forage, it should be expected that it would perform better under the "high wheat - low cattle" situation. This is the case at seven of the nine sites. Arapahoe is ranked eighth based on the average net returns under median prices, but improves to fourth under the "high wheat - low cattle" scenario.

Pioneer 2157 (Figure 4.4) ranks second in forage production and twelfth in grain production. The overall rank

of Pioneer 2157 is improved at 8 of the 9 sites under the "low wheat-high cattle" price scenario. Pioneer 2157's average rank under the median prices is sixth, but improves to third under the "low wheat - high cattle". Under the "high wheat-low cattle" scenario, its average rank drops to eighth.

Chisholm is a consistent variety which produces forage and grain at approximately the same level, ranking eighth in forage and seventh in grain production. As illustrated in Figure 4.5, with the exception of Buffalo (1989-90), this variety's rankings do not change significantly under the different price structures. Average rank is tenth under the median situation and is the same under the other price situations. The variety's rank changes no more than two places as a result of changes in the wheat-cattle price ratio. Chisholm is representative of many of the other varieties in that most are fairly consistent in the production of both grain and forage. Arapahoe and Pioneer 2157 were chosen because they represented the extremes in the production of either grain or forage. The change in ranking was more severe with Arapahoe and Pioneer 2157 which is expected given their relative production advantage in either area.

Summary and Conclusions

It is difficult to make definitive recommendations based upon these results. However, these twelve varieties have been economically evaluated using three different forage allocation methods and three economic scenarios. Karl, Thunderbird, and

Pioneer 2180 consistently produce the highest net return levels of the twelve varieties. A summary table providing the rank of each variety under the different allocation methods, the ranking of forage and grain production. Karl clearly is the top performing variety in all three methods, with Thunderbird and Pioneer 2180 competing for the second spot. Sierra and Mesa consistently rank low in all analyses performed.

A diverse set of evaluation sites and production practices were used so that the varieties could be evaluated under different circumstances and different environments. However, this evaluation is too small to be considered a state-wide average, yet it does provide valuable economic information about the performance characteristics of these twelve varieties.

This analysis should provide more information about the economic significance, and relative importance of not only grain production, but also the timing and total production of forage growth. The effects of different forage allocation methods and price structures have also been determined, which all play significant roles in the net return levels that each can produce. Although net return levels change under the different allocation methods, relative rank does not. Those varieties which perform well in one method seem to perform well under the other methods as well. The varieties which did not perform well in this analysis could still be valuable for diversification purposes and possibly under different

production conditions.

TABLE 4.1
VARIETIES OF WHEAT EVALUATED

BRAND	VARIETY
AGRIPRO	ABILENE
AGRIPRO	SIERRA
AGRIPRO	THUNDERBIRD
AGRIPRO	MESA
AGSECO	7846
PIONEER	2157
PIONEER	2180
-	TAM 200
-	TAM W-101
-	CHISHOLM
-	ARAPAHOE
-	KARL

TABLE 4.2

LOCATION AND YEAR FOR VARIETY SELECTION ANALYSIS

LOCATION	YEAR
BUFFALO	1989-90
PURCELL	1989-90
CHICKASHA	1990-91
HASKELL	1991-92
FREDRICK	1990-91, 1991-92
MARSHALL	1989-90, 1990-91, 1991-92

TABLE 4.3

STOCKER BUDGET FOR VARIETY SELECTION ANALYSIS

	UNIT	PRICE	QUANTITY	VALUE
LIVESTOCK RECEIPTS				
STEERS	cwt	88.46	6.80	601.53
LESS DEATH LOSS	cwt		0.07	6.02
TOTAL RECEIPTS			6.73	595.51
OPERATING INPUTS				
Steers Calves	cwt	104.22	4.50	468.99
Supplemental Hay	lb	0.03	200.00	6.00
Salt & Mineral	lb	0.15	28.75	4.31
Freight	cwt	0.35	6.73	2.36
Marketing	cwt	1.72	6.73	11.58
Vet Expenses	hd	8.00	1.00	8.00
Mach. & Equip	hd	6.09	1.00	6.09
Labor	hd	5.00	1.27	6.35
Interest	dol	0.12	164.09	19.69
TOTAL OPERATING COSTS				533.37
RETURN ABOVE OPERATING COSTS		(\$/HEAD)		62.14

TABLE 4.4
FORAGE YIELDS AND RANKINGS

VARIETY	1989-90 :BUFFALO	1989-90 MARSHALL	1989-90 PURCELL	1990-91 CHICKASHA	1990-91 MARSHALL	1990-91 FREDRICK	1991-92 HASKELL	1991-92 MARSHALL	1991-92 FREDRICK	AVERAGE
2157	: 1,557 (1)	1,521 (3)	1,623 (2)	2,649 (4)	1,226 (3)	2,933 (2)	2,381 (3)	1,457 (2)	736 (1)	1,787 (2)
TAM 200	: 867 (9)	1,258 (6)	1,433 (3)	2,488 (7)	1,033 (7)	2,774 (4)	2,204 (5)	1,304 (4)	461 (4)	1,536 (6)
MESA	: 1,094 (3)	1,142 (9)	1,249 (8)	2,510 (6)	669 (11)	1,598 (11)	2,099 (7)	1,566 (1)	590 (3)	1,391 (7)
KARL	: 979 (6)	1,538 (2)	1,427 (5)	2,755 (2)	1,123 (4)	2,682 (5)	2,468 (2)	1,215 (6)	294 (7)	1,609 (4)
ABILENE	: 758 (10)	1,416 (4)	1,215 (9)	2,298 (10)	927 (9)	2,006 (10)	1,543 (10)	1,168 (7)	194 (10)	1,281 (10)
ARAPAHOE	: 714 (12)	509 (12)	972 (12)	2,194 (11)	928 (8)	2,194 (9)	1,497 (11)	817 (12)	46 (12)	1,097 (11)
CHISHOLM	: 913 (8)	1,144 (8)	1,177 (10)	2,408 (9)	1,079 (6)	2,582 (6)	1,788 (8)	1,093 (9)	272 (9)	1,384 (8)
THUNDERBIRD	: 1,023 (4)	1,024 (10)	1,429 (4)	2,623 (5)	1,550 (1)	3,328 (1)	2,170 (6)	1,368 (3)	283 (8)	1,644 (3)
2180	: 1,228 (2)	2,090 (1)	1,939 (1)	2,759 (1)	1,121 (5)	2,290 (8)	2,836 (1)	1,284 (5)	675 (2)	1,802 (1)
7846	: 972 (7)	1,305 (5)	1,129 (11)	2,470 (8)	843 (10)	2,430 (7)	1,690 (9)	960 (11)	306 (6)	1,345 (9)
TAM W-101	: 999 (5)	1,212 (7)	1,350 (6)	2,689 (3)	1,357 (2)	2,859 (3)	2,297 (4)	1,072 (10)	382 (5)	1,580 (5)
SIERRA	: 777 (11)	527 (11)	1,322 (7)	1,556 (12)	336 (12)	1,530 (12)	1,402 (12)	1,156 (8)	159 (11)	974 (12)
AVERAGE	990	1,224	1,355	2,450	1,016	2,434	2,031	1,205	367	
MINIMUM	714	509	972	1556	336	1530	1402	817	46	
MAXIMUM	1557	2090	1939	2759	1550	3328	2836	1566	736	
STD DEV.	221	411	240	318	303	517	426	200	202	

TABLE 4.5
GRAIN YIELDS AND RANKINGS

VARIETY	1989-90 :BUFFALO	1989-90 MARSHALL	1989-90 PURCELL	1990-91 CHICKASHA	1990-91 MARSHALL	1990-91 FREDRICK	1991-92 HASKELL	1991-92 MARSHALL	1991-92 FREDRICK	AVERAGE
2157	: 16.2 (12)	16.7 (10)	24.2 (8)	45.7 (12)	13.1 (8)	39.5 (7)	14.6 (7)	18.1 (12)	39.8 (8)	25.32 (12)
TAM 200	: 27.5 (3)	16.2 (11)	21.2 (11)	46.1 (11)	13.6 (6)	46.7 (3)	13.7 (9)	23.2 (11)	46.2 (3)*	28.27 (9)
MESA	: 22.1 (6)	23.5 (5)	24.4 (7)	51.1 (6)	17.0 (2)	39.4 (8)*	13.2 (10)	30.0 (8)	38.5 (9)	28.80 (8)
KARL	: 24.2 (4)	27.7 (3)	28.7 (3)	58.5 (3)	14.5 (4)	38.8 (11)	28.3 (1)	41.6 (2)	38.4 (10)	33.41 (1)
ABILENE	: 28.3 (2)	27.8 (2)	22.4 (10)	59.5 (2)	17.9 (1)	41.6 (5)	11.4 (11)	39.4 (3)	34.8 (11)	31.46 (5)
ARAPAHOE	: 28.9 (1)	26.3 (4)	30.5 (1)	49.0 (9)	13.9 (5)	49.0 (1)	14.7 (6)	42.0 (1)	46.2 (3)*	33.39 (2)
CHISHOLM	: 23.4 (5)	20.4 (8)	19.4 (12)	50.3 (8)	13.2 (7)	39.3 (10)	17.0 (3)	32.6 (5)	43.8 (5)	28.82 (7)
THUNDERBIRD	: 20.9 (9)	28.0 (1)	28.6 (4)	50.8 (7)	15.9 (3)	38.3 (12)	16.7 (4)	35.4 (4)	27.5 (12)	29.12 (6)
2180	: 16.9 (11)	15.5 (12)	29.1 (2)	52.4 (5)	9.2 (12)	39.4 (8)*	14.2 (8)	29.5 (9)	42.7 (7)	27.66 (10)
7846	: 21.2 (7)	20.9 (7)	27.4 (6)	55.6 (4)	12.5 (10)	46.8 (2)	19.3 (2)	28.5 (10)	53.8 (2)	31.78 (4)
TAM W-101	: 17.1 (10)	17.8 (9)	23.5 (9)	47.7 (10)	12.6 (9)	39.7 (6)	9.4 (12)	31.2 (7)	43.1 (6)	26.90 (11)
SIERRA	: 21.0 (8)	22.8 (6)	27.8 (5)	59.7 (1)	12.0 (11)	46.1 (4)	15.8 (5)	32.2 (6)	56.5 (1)	32.66 (3)
AVERAGE	22.3	22.0	25.6	52.2	13.8	42.1	15.7	32.0	42.6	
MINIMUM	16.2	15.5	19.4	45.7	9.2	38.3	9.4	18.1	27.5	
MAXIMUM	28.9	28.0	30.5	59.7	17.9	49.0	28.3	42.0	56.5	
STD DEV.	4.2	4.6	3.4	4.8	2.2	3.7	4.5	6.8	7.5	

*Denotes Tie

TABLE 4.6

NET RETURNS AND RANKINGS -- 14 POUND ALLOCATION

VARIETY	1989-90 :BUFFALO	1989-90 MARSHALL	1989-90 PURCELL	1990-91 CHICKASHA	1990-91 MARSHALL	1990-91 FREDRICK	1991-92 HASKELL	1991-92 MARSHALL	1991-92 FREDRICK	AVERAGE
2157	:\$44.01 (5)	\$31.02 (7)	\$17.48 (4)	\$153.93 (9)	\$8.74 (5)	\$130.34 (4)	\$47.60 (3)	\$44.77 (12)	\$67.38 (8)	\$60.59 (5)
TAM 200	: 51.07 (1)	19.29 (11)	1.09 (10)	148.87 (11)	2.74 (7)	145.75 (1)	38.02 (5)	54.12 (11)	80.34 (3)	60.14 (7)
MESA	: 43.70 (6)	36.68 (5)	3.53 (9)	164.73 (6)	-1.22 (9)	78.11 (12)	32.43 (7)	84.71 (5)	60.17 (9)	55.87 (11)
KARL	: 45.53 (4)	64.68 (1)	23.35 (2)	196.46 (1)	8.94 (4)	118.48 (7)	92.09 (1)	105.86 (1)	53.15 (10)	78.73 (1)
ABILENE	: 49.23 (3)	60.23 (2)	-3.79 (11)	181.68 (2)	11.51 (3)	100.58 (10)	5.41 (12)	97.43 (2)	40.09 (11)	60.26 (6)
ARAPAHOE	: 49.32 (2)	20.46 (10)	11.06 (6)	146.14 (12)	-0.45 (8)	130.09 (5)	13.52 (10)	91.58 (4)	70.93 (5)	59.18 (8)
CHISHOLM	: 40.56 (7)	27.46 (8)	-14.27 (12)	158.36 (8)	3.33 (6)	116.09 (8)	31.74 (8)	74.12 (7)	68.86 (7)	56.25 (10)
THUNDERBIRD	: 37.34 (8)	45.59 (4)	23.13 (3)	168.22 (5)	29.75 (1)	142.10 (2)	45.70 (4)	93.21 (3)	20.21 (12)	67.25 (3)
2180	: 33.31 (10)	49.55 (3)	44.47 (1)	178.31 (3)	-7.04 (10)	105.03 (9)	64.10 (2)	72.25 (8)	74.70 (4)	68.30 (2)
7846	: 36.26 (9)	35.22 (6)	7.86 (7)	176.67 (4)	-7.95 (11)	132.67 (3)	34.83 (6)	56.64 (10)	99.63 (2)	63.54 (4)
TAM W-101	: 25.01 (12)	22.30 (9)	4.76 (8)	161.49 (7)	12.34 (2)	128.06 (6)	28.74 (9)	69.10 (9)	69.25 (6)	57.89 (9)
SIERRA	: 28.07 (11)	10.66 (12)	16.57 (5)	153.42 (10)	-29.17 (12)	95.57 (11)	13.12 (11)	75.37 (6)	104.39 (1)	52.00 (12)
AVERAGE	\$40.28	\$35.26	\$11.27	\$165.69	\$2.63	\$118.57	\$37.28	\$76.60	\$67.43	\$61.67
MINIMUM	25.01	10.66	-14.27	146.14	-29.17	78.11	5.41	44.77	20.21	52.00
MAXIMUM	51.07	64.68	44.47	196.46	29.75	145.75	92.09	105.86	104.39	78.73
STD. DEV	8.10	16.15	14.58	14.48	13.62	19.43	22.73	17.93	22.12	6.78

TABLE 4.7

NET RETURNS AND RANKINGS -- 24 POUND ALLOCATION

VARIETY	1989-90 :BUFFALO	1989-90 MARSHALL	1989-90 PURCELL	1990-91 CHICKASHA	1990-91 MARSHALL	1990-91 FREDRICK	1991-92 HASKELL	1991-92 MARSHALL	1991-92 FREDRICK	AVERAGE
2157	:\$18.78(9)	\$6.37(9)	\$8.82(6)	\$111.00(10)	\$11.12(5)	\$82.81(5)	\$9.02(4)	\$21.16(12)	\$79.31(5)	\$34.28(12)
TAM 200	: 37.02(2)	-1.10(12)	-22.14(10)	108.55(12)	-14.00(7)	100.80(1)	2.30(7)	32.99(11)	87.81(3)	36.91(7)
MESA	: 25.97(5)	18.17(4)	-16.71(8)	124.05(7)	-12.06(6)	52.22(12)	-1.58(8)	59.33(5)	69.73(9)	35.46(9)
KARL	: 29.66(4)	39.75(1)	0.23(2)	151.81(1)	-9.26(3)	75.01(7)	52.09(1)	86.17(1)	57.92(10)	53.71(1)
ABILENE	: 36.95(3)	37.29(2)	-23.48(11)	144.44(2)	-3.51(2)	68.07(10)	-19.60(12)	78.50(2)	43.23(11)	40.21(6)
ARAPAHOE	: 37.75(1)	12.21(7)	-4.70(4)	110.58(11)	-15.49(9)	94.54(2)	-10.74(11)	78.34(3)	71.67(8)	41.57(4)
CHISHOLM	: 25.77(6)	8.92(8)	-33.34(12)	119.33(8)	-14.16(8)	74.24(8)	2.76(6)	56.40(7)	73.26(7)	34.80(10)
THUNDERBIRD	: 20.76(7)	28.99(3)	-0.03(3)	125.71(6)	4.63(1)	88.17(4)	10.53(3)	71.04(4)	24.79(12)	41.62(3)
2180	: 13.41(11)	15.68(5)	13.04(1)	133.60(4)	-25.21(11)	67.92(11)	18.14(2)	51.44(9)	85.64(4)	41.52(5)
7846	: 20.50(8)	14.07(6)	-10.43(7)	136.64(3)	-21.61(10)	93.29(3)	7.44(5)	41.09(10)	104.59(2)	42.84(2)
TAM W-101	: 8.82(12)	2.66(10)	-17.12(9)	117.91(9)	-9.65(4)	81.73(6)	-8.49(9)	51.73(8)	75.44(6)	33.67(11)
SIERRA	: 15.48(10)	2.12(11)	-4.85(5)	128.20(5)	-34.62(12)	70.77(9)	-9.60(10)	56.63(6)	106.97(1)	36.79(8)
AVERAGE	\$24.24	\$15.43	-\$10.70	\$125.99	-\$13.84	\$79.13	\$4.36	\$57.07	\$73.36	\$39.45
MINIMUM	8.82	-1.10	-33.34	108.55	-34.62	52.22	-19.60	21.16	24.79	33.67
MAXIMUM	37.75	39.75	13.04	151.81	4.63	100.80	52.09	86.17	106.97	53.71
STD. DEV	9.26	12.95	12.09	13.11	9.67	13.21	17.66	18.58	22.41	5.32

TABLE 4.8
NET RETURNS AND RANKINGS -- METHOD II

VARIETY	1989-90 : PURCELL	1990-91 CHICKASHA	1990-91 MARSHALL	AVERAGE
2157	: -7.50(5)	116.56(11)	-6.55(3)	34.17(4)
TAM 200	: -18.95(7)	113.92(12)	-22.51(6)	24.15(9)
MESA	: -34.04(11)	128.97(7)	-76.85(11)	6.03(11)
KARL	: 3.46(2)	155.17(1)	-11.74(4)	48.96(1)
ABILENE	: -18.17(6)	153.21(2)	-33.81(8)	33.74(5)
ARAPAHOE	: -26.78(8)	121.36(10)	-45.81(9)	16.26(10)
CHISHOLM	: -27.68(9)	125.45(8)	-15.64(5)	27.38(7)
THUNDERBIRD	: 3.19(3)	129.34(6)	6.04(1)	46.19(2)
2180	: 11.32(1)	136.78(5)	-27.64(7)	40.15(3)
7846	: -4.30(4)	143.00(4)	-58.08(10)	26.87(8)
TAM W-101	: -28.00(10)	122.90(9)	-6.35(2)	29.52(6)
SIERRA	: -45.18(12)	143.11(3)	-148.33(12)	-16.80(12)

AVERAGE	-16.05	132.48	-37.27	26.39
MINIMUM	-45.18	113.92	-148.33	-16.80
MAXIMUM	11.32	155.17	6.04	48.96
STD. DEV	16.56	13.14	40.44	17.33

TABLE 4.9

SUMMARY OF RANKINGS BASED UPON FORAGE PRODUCTION,
GRAIN PRODUCTION, AND ECONOMIC RETURNS

VARIETY	FORAGE	GRAIN	METHOD I		METHOD II
			14	24	
PIONEER 2157	2	12	5	12	4
TAM 200	6	9	7	7	9
MESA	7	8	11	9	11
KARL	4	1	1	1	1
ABILENE	10	5	6	6	5
ARAPAHOE	11	2	8	4	10
CHISHOLM	8	7	10	10	7
THUNDERBIRD	3	6	3	3	2
PIONEER 2180	1	10	2	5	3
AGSECO 7846	9	4	4	2	8
TAM W-101	5	11	9	11	6
SIERRA	12	3	12	8	12

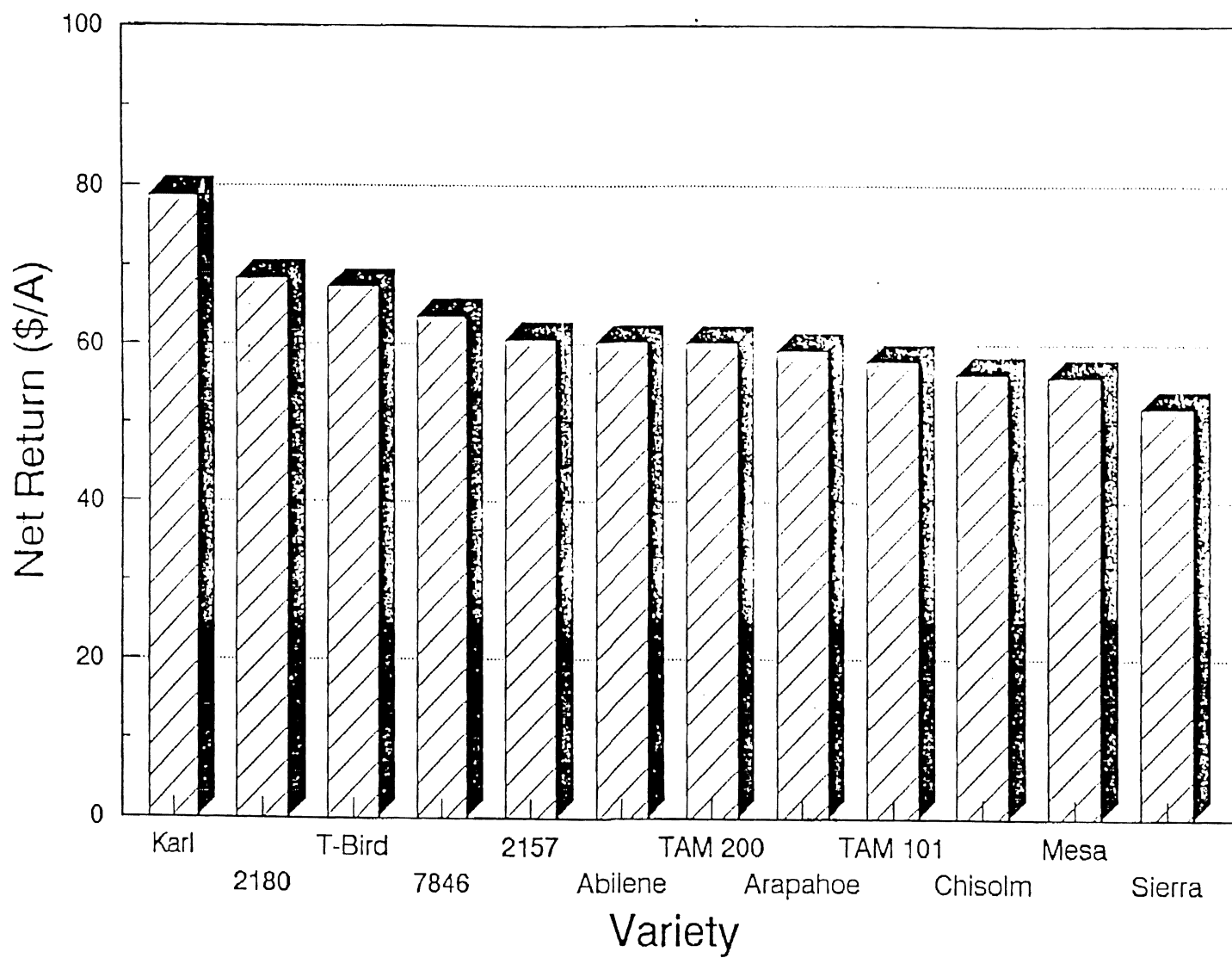


Figure 4.1. Net Returns (\$/Acre) Under 14 Pound Allocation

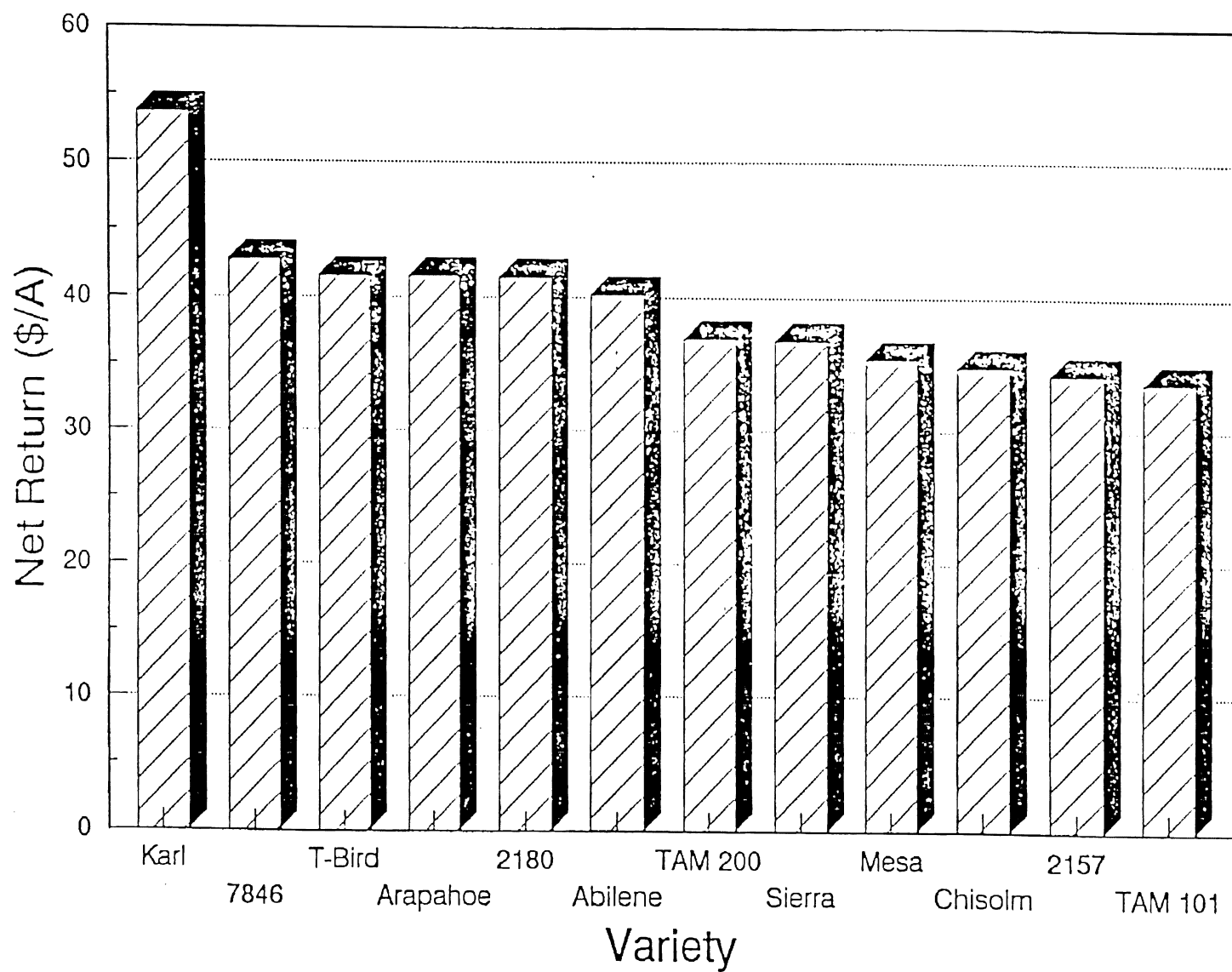
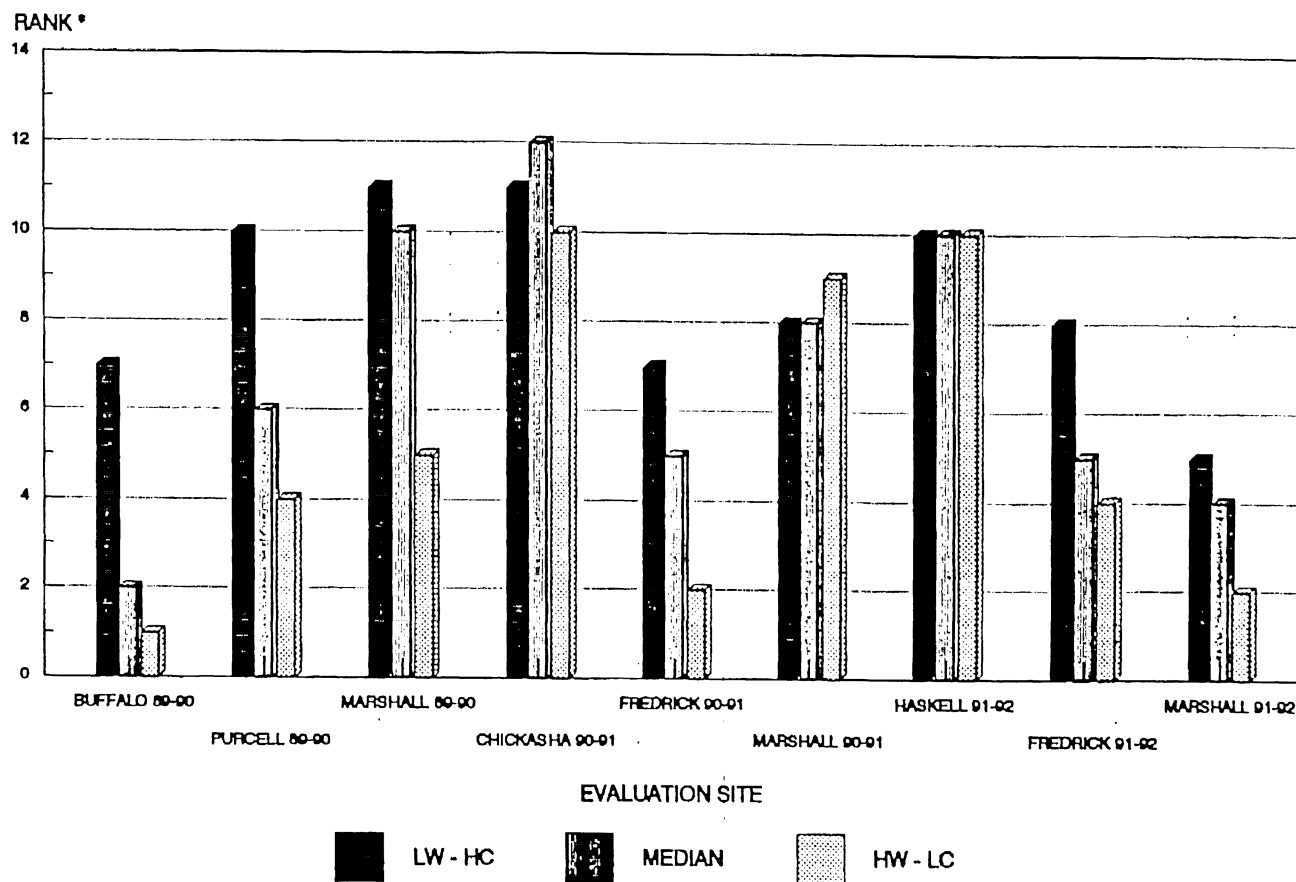


Figure 4.2. Net Return (\$/Ac) Under 24 Pound Allocation

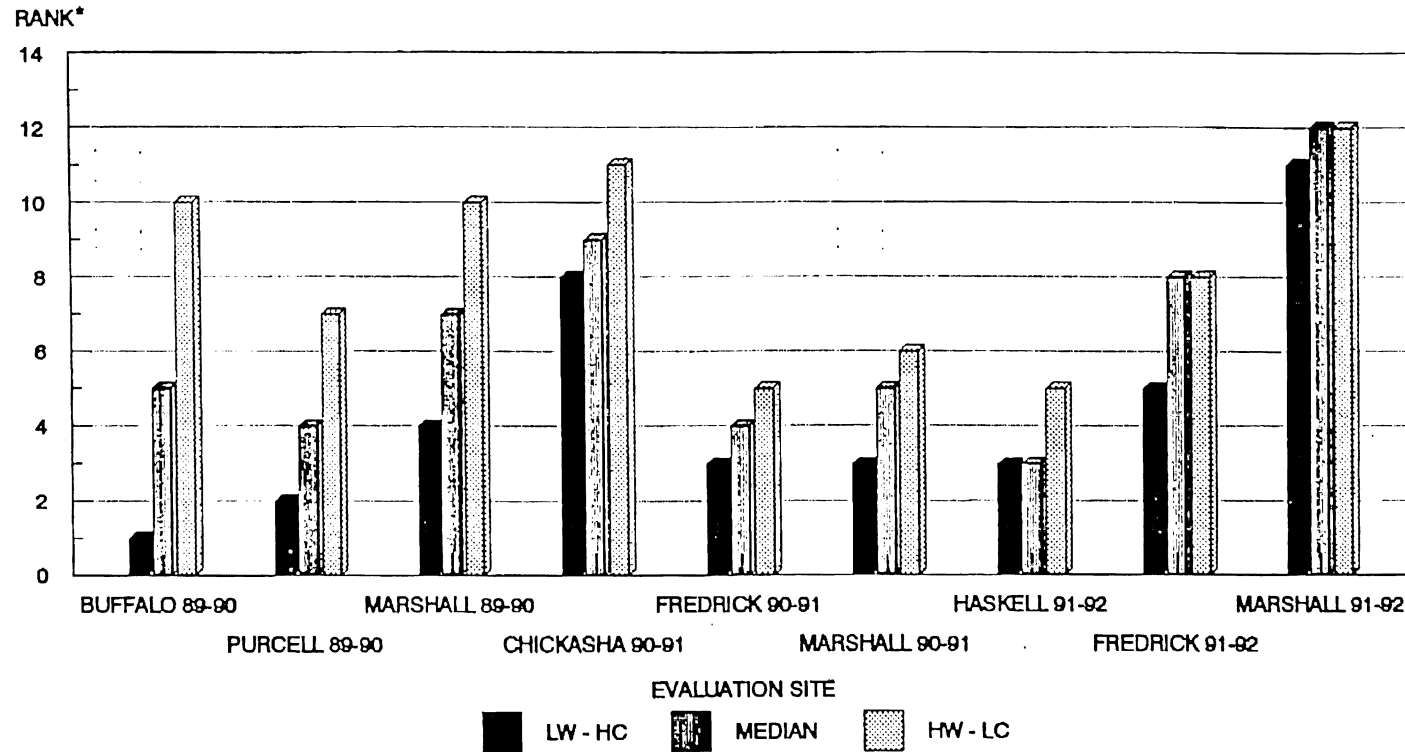
ARAPAHOE



*The rank of the variety is included on the vertical axis, however, a high rank will be denoted by a low spike. Therefore, those locations having high spikes ranked low at that location.

Figure 4.3. Effect of Alternative Wheat and Cattle Price Combinations on the Net Return Ranking for the Arapahoe Wheat Variety

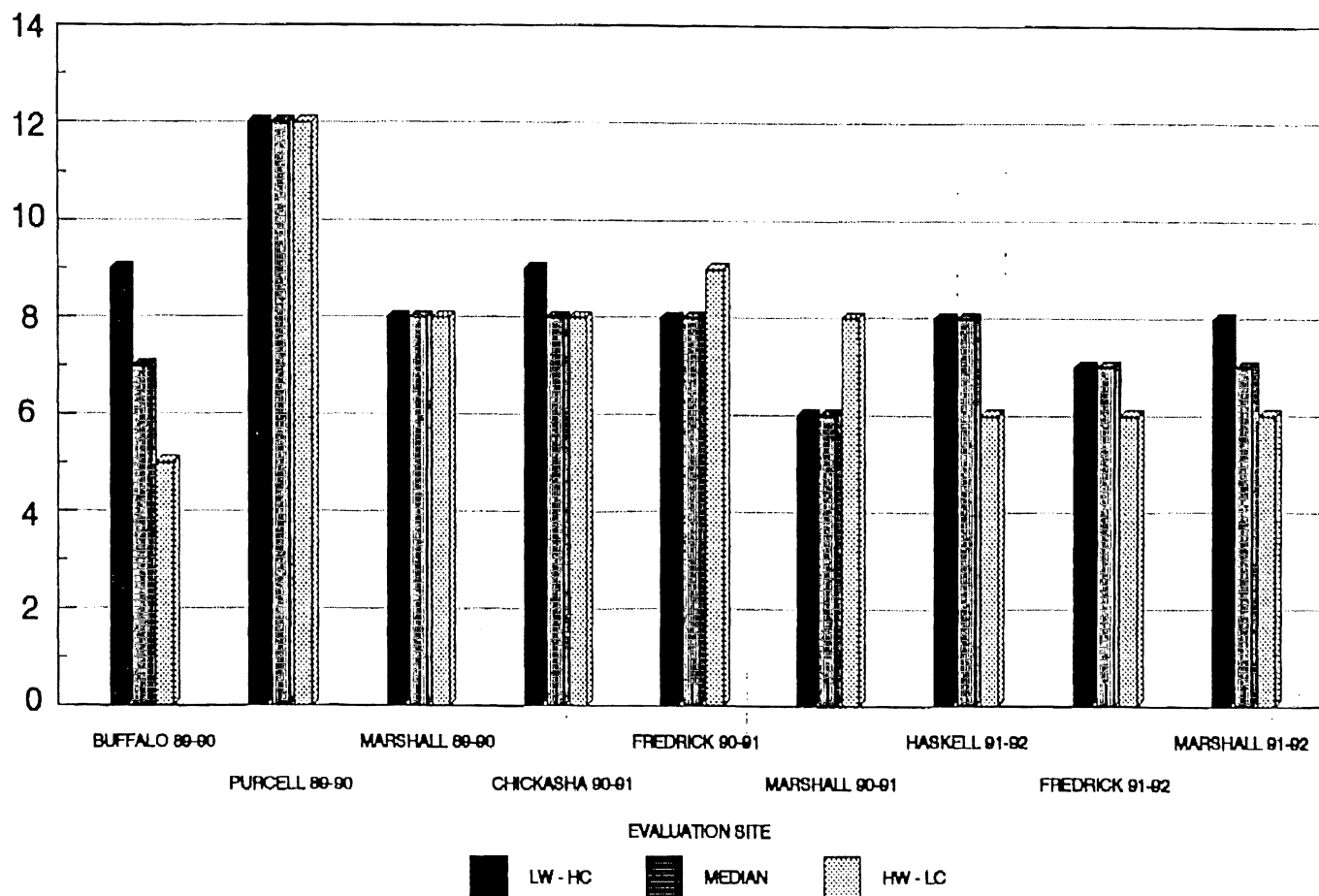
PIONEER 2157 14 POUNDS



*The rank of the variety is included on the vertical axis, however, a high rank will be denoted by a low spike. Therefore, those locations having high spikes ranked low at that location.

Figure 4.4. Effect of Alternative Wheat and Cattle Price Combinations on the Net Return Ranking for the Pioneer 2157 Wheat Variety

RANK*



* The rank of the variety is included on the vertical axis, however, a high rank will be denoted by a low spike. Therefore, those locations having high spikes ranked low at that location.

Figure 4.5. Effect of Alternative Wheat and Cattle Price Combinations on the Net Return Ranking for the Chisholm Wheat Variety

CHAPTER V

VALUE OF WHEAT JOINTING DATE INFORMATION

The grazing of livestock on winter wheat forage production is a common practice in Oklahoma and other Southern Plains states. It is possible to graze livestock, particularly stocker cattle, on early vegetation until the jointing stage (when the first node of the stem is visible, or stage 6 of the Feekes scale; Large, 1954). Grazing past jointing can cause a significant reduction in grain production. Animals must be removed before floral initiation, or jointing, to prevent yield reductions (Croy, 1984).

In a 1988 survey of Oklahoma wheat pasture utilization systems it was found that, in a typical year, the average date producers removed livestock from winter wheat pasture was March 8 (Walker et al., 1988). In years that produced below normal forage production livestock were removed on February 26, while in high forage production years an average removal date of March 23 was identified (Walker et al., 1988). The practice of utilizing a fixed removal date is suspect due to the number of variables that are involved in determining jointing date. The survey also indicated that most producers preferred to remove cattle from wheat pasture prior to the joint stage of wheat development, and they were more likely to

use jointing indicators to determine the termination of grazing rather than a fixed removal date.

The growth and development of wheat plants is determined by a number of factors. Leaf growth and tillering or stooling are markedly influenced by climatic conditions (temperature, light intensity, day-length, rainfall) and the nutritional status under which the plants are grown (Evans, 1975). Stem elongation is also very much controlled by climate and is related to varietal maturity (Croy, 1984). Jointing generally occurs in central Oklahoma between March 5 and March 20 (Krenzer, et al.). Producers should be able to identify jointing with close observation.

Obviously, the ability to perfectly identify wheat jointing date is the ideal situation for those producers who wish to harvest their wheat for grain. In this case, producers would be able to graze cattle right up to jointing while causing no decrease in grain production. Therefore, it would be possible to maximize both livestock and grain revenue. If cattle are grazed past jointing, grain production is diminished; if cattle are removed too early, an opportunity cost of lost livestock revenue is incurred.

Like any other forecast or prediction of an uncertain variable, the ability to determine jointing date has potential economic value in decision making. The economic value of determining jointing date will vary from year to year due to fluctuations in wheat and cattle prices, climate, yield potential, and stocker gains. However, regardless of the

relative price structure or environmental conditions, the ability to more accurately determine the jointing date should provide the opportunity for increasing net returns.

The objective of this study is to determine the economic value of wheat jointing date forecasts. The ability to accurately predict jointing date in grazed wheat should provide the producer with the ability to maximize net returns, in that cattle can be grazed until jointing and removed prior to any decrease in grain yields. Producers attitudes concerning risk will also affect the relative value of information. For this reason, all determinations will be evaluated under alternative risk preferences to ascertain how the value of information changes under alternative risk preferences. Sensitivity analysis will also be performed to determine the effects of alternative price structures on the value of jointing date information.

Methodology

Interest in ascertaining decision makers' willingness to pay for information has increased in recent years. Much of this interest has focused on estimating the value of various forms of climate forecasts in making crop production decisions (e.g. Mjelde and Cochran, 1988; Sonka et al., 1987). Information value has shown to be dependent upon several factors, including the structure of the decision set, the decision maker's prior knowledge, the nature of the information, and the payoffs associated with various outcomes.

The use of jointing date information to determine the removal date of cattle grazing wheat pasture provides a unique joint product application of value of information techniques.

Empirical studies on the value of information are typically based upon decision theory and often employ the assumption of risk neutral decision preferences for ease of computation. More recent applications have focused on the effect of risk preferences on the value of climate forecasts (Mjelde and Cochran, 1988).

Under the assumption of risk neutrality, the decision maker is strictly concerned with maximizing net returns. In the case of wheat pasture grazing, the decision maker is concerned with selecting the grazing termination date, X , given uncertainty in the date of jointing. Let θ represent the stochastic jointing date and $p(\theta)$ represent the decision maker's prior knowledge about the distribution of jointing date. In the absence of jointing date information (i.e., use of a calendar date strategy), the problem facing the decision maker may be expressed as

$$\max_X \int NR(f(X, \theta), g(X, \theta)) p(\theta) d\theta$$

where $f(X, \theta)$ is a response function for grain production and $g(X, \theta)$ is a response function for livestock production. Both response functions represent total production as a function of the jointing date and grazing termination date, *ceteris paribus*. Beyond the jointing date, cattle and wheat are competitive products, in that extension of the grazing period will decrease grain yields (i.e., $\partial f(X)/\partial X < 0$), but increase

livestock production from grazing (i.e., $\partial g(X)/\partial X > 0$). The risk neutral producer would select the grazing termination date that maximizes expected net returns, X^* .

If the decision maker utilizes jointing date information, $p(\theta)$ is revised to $p(\theta|F_i)$, where F_i is the jointing date forecast. The decision problem is changed to

$$\max_X \int NR(f(X, \theta), g(X, \theta)) p(\theta|F_i) d\theta$$

The value of information provided by a particular jointing date forecast (VI_i) may be estimated as

$$VI_i = \max \int NR(f(X, \theta), g(X, \theta)) p(\theta|F_i) d\theta - \int NR(f(X^*, \theta), g(X^*, \theta)) p(\theta|F_i) d\theta$$

That is, the value of the jointing date prediction is the difference between expected net returns earned from using the forecast optimally and net returns earned under the calendar date strategy (X^*).

If the producer possesses the ability to predict jointing date, several jointing date forecasts are possible. Thus, the value of using a jointing date criterion for determining grazing termination date is

$$VI_i = \int [\max \int NR(f(X, \theta), g(X, \theta)) p(\theta|F_i) d\theta - \int NR(f(X^*, \theta), g(X^*, \theta)) p(\theta|F_i) d\theta] dF_i$$

That is, the value of jointing date information in the aggregate is the value of each forecast summed over all possible forecasts.

Stochastic dominance procedures can be used to relax the assumption of risk neutrality and determine information value

under alternative risk preferences. The use of efficiency criterion to order risky preferences has been well documented in agriculture. Stochastic dominance has been widely used to order risky production alternatives based upon set criteria. First-degree stochastic dominance (FSD) holds for all decision makers who have positive marginal utility, that is all decision makers who prefer more to less. Second-degree stochastic dominance (SSD) holds for all decision makers whose utility functions have positive, non-increasing slopes at all outcome levels (Barry, 1984). These individuals are risk averse.

Generalized stochastic dominance (GSD) is more discriminating and allows for the ranking of management strategies consistent with expected utility maximization. GSD reduces the choice set of alternatives to a smaller subset that insures that the strategy which has the highest expected utility for the specific class of admissible utility functions is included in the subset. The subset is labeled the efficient set. GSD orders uncertain outcomes for decision makers whose absolute risk aversion functions lie within specified lower and upper bounds (Barry, 1984). These bounds, sometimes termed Pratt-Arrow absolute risk aversion intervals, are used to identify the risk preferences of individuals. The absolute risk aversion function is defined as:

$$(1) \quad r(x) = -U''(x)/U'(x)$$

where $U'(x)$ and $U''(x)$ are the first and second derivatives of a von Nuemann-Morganstern utility function, $U(x)$. Under GSD,

$F(x)$ dominates $G(x)$ when $\int [G(x) - F(x)] U'(x) dx \geq 0$ for all utility functions meeting the condition $r_1(x) \leq r(x) \leq r_2(x)$ for all x .

A decision maker's willingness to pay for information can be thought of as a premium, π , (Cochran and Mjelde, 1987). Stochastic dominance procedures can be used to estimate the premium (π) of the value of information. An upper and lower bound on the premium can be estimated by comparing two distributions. The first distribution, $F(x)$, is generated by using the perfect information. The second distribution, $G(x)$, is generated based upon a decision maker's prior knowledge, or one of the other removal strategies.

The lower bound on the value of information is the minimum value of the premium, π , such that $F(x-\pi)$ no longer dominates $G(x)$. The premium is subtracted from each element of $F(x)$. The upper bound on the value of information is the minimum premium such that $G(x)$ dominates $F(x-\pi)$. Therefore, the upper bound corresponds to the minimum shift in the dominant distribution that is required for it to be dominated by the comparison distribution. The lower bound corresponds to the minimum shift in the dominant distribution that produces an efficient set with both the dominant and comparison distributions as members. Mathematically, the bounds on information value can be defined as:

upper: Min such that $EU(F(x-\pi) - EU(G(x))) < 0 \forall U \in \mu$
 lower: Min such that $EU(F(x-\pi) - EU(G(x))) \leq 0$ for at least
 one $U \in \mu$

where: π = premium

EU = expected utility

μ = admissible set of utility functions

These bounds on the premium can be interpreted as estimates of the value of information contained in the dominant distribution. They indicate the willingness of decision makers, represented by the preference interval, to pay for the information (Raskin and Cochran, 1988).

Wheat-Stocker Production and the Value of Jointing Date Information

A wheat crop simulation model (CERES-Wheat) is used to estimate jointing date and grain yield over a forty year period in central Oklahoma. The effect of livestock grazing past jointing on grain yield was estimated using experimental data from a recent grazing termination study. Net returns under alternative grazing termination date strategies are then estimated based upon grain yield and livestock production. The alternative cattle removal strategies are evaluated by comparing the 40-year net return distributions using generalized stochastic dominance (GSD) procedures. GSD is also used to determine the value of jointing date information. Using perfect information as the basis of comparison, alternative removal dates are evaluated and the value of information determined.

CERES Model

Grain yield and jointing date were estimated using the

CERES-Wheat model (Ritchie and Otter, 1985). CERES-Wheat is a difference equations model that simulates daily growth and development of a wheat plant using climatic, hydrological, phenological and biological relationships. Phasic development of the wheat plant is simulated and dependent upon both plant genetics and environment. The model simulates extension growth of leaves and stems, as well as senescence of leaves, biomass accumulation, and partitioning (Rodriguez et al., 1989).

Inputs required by the CERES-Wheat model include weather, soil, genetic and management data. Historical weather data from 1950 to 1989 at Kingfisher, Oklahoma are used to simulate growth and development. The required weather data includes daily solar radiation, maximum and minimum air temperature, and precipitation. The soil was specified to reflect a Kirkland silt loam. Planting date is determined based upon available soil moisture and a seeding rate of 1.5 bushels/acre was employed. The CERES-Wheat model has been validated for use in a central Oklahoma by Rodriguez et al., (1989). Detailed description of all input parameters and computational procedures used in CERES-Wheat can be found in Ritchie and Otter (1985).

Penalty on Grain Yield

Experimental data is used to determine the average loss in grain production when cattle graze past jointing. Data used to determine grain yield losses are based upon trials conducted by the Agronomy Department at Oklahoma State

University (Krenzer, unpublished data).

The grazing termination date experiment was conducted on the OSU wheat pasture research facility located in Marshall, Oklahoma during the 1989-90, 1990-91, and 1991-92 production seasons. Seven termination dates and one control treatment were evaluated. To simulate grazing termination, enclosures were placed on grazed wheat at one week intervals beginning on February 1. At this time stage of maturity with respect to growing point elevation was determined in order to accurately describe conditions at termination of grazing.

Regression analysis was performed on the data to determine the relationship between grazing past jointing date and actual grain loss. The following response function was estimated

$$\begin{aligned} Y_a &= Y_p \quad \forall X \leq X^* \\ Y_a &= Y_p * [1 - .0325(X - X^*)] \quad \forall X > X^* \end{aligned}$$

where,

Y_a = actual grain yield
 Y_p = potential grain yield (ungrazed)
 X = grazing termination date
 X^* = jointing date

Therefore, the average decrease in grain yield is 3.25 percent of total grain yield for each day of grazing after jointing. The grazing penalty function is applied to the grain yields estimated from CERES-Wheat to determine actual grain yields. Potential grain yields were determined from the CERES model. If grazing takes place after jointing, the appropriate penalty on grain yields was imposed. The adjusted grain yield is then used to calculate revenue from the sale of grain.

Wheat Production Budget

A representative wheat production budget was developed based upon farm data from North Central Oklahoma (Teague et al., 1992). The wheat production budget is calculated on a per-acre basis and is included as Table 5.1. The budget provides a return above operating costs; no fixed costs are included.

Wheat production costs are \$78.02 per acre plus hauling charge, which is a function of grain yield and will vary each year. Wheat seed cost are \$5.72/acre. Fertilizer expenses total \$19.98/acre, while herbicide and insecticide expenses are \$9.35/acre. Custom harvest expenses total \$14.04/acre, and machinery and equipment costs are \$17.97/acre. The interest expense, based on the annual interest rate of 12 percent, totals \$5.68/acre .

Grain yield is determined from the CERES model and is multiplied by the price of \$3.00/bushel to determine wheat revenue. The wheat price reflects the average price (1991 dollars) received by farmers over the 10 year period from 1982-91.

Stocker Budget

The stocker cattle production budget reflects the average price situation over the ten year period from 1982-91 (1991 dollars). Purchase and selling prices represent the average price at the Oklahoma National Stockyards of No. 1 Medium

frame steer calves purchased in November and sold in March. Steer calves were purchased weighing 450 pounds at a cost of \$104.22/cwt. Selling price is for the same calves weighing approximately 680 pounds at a price of \$88.46/cwt. Weight gain is assumed to be 2 lbs/day, which is consistent with three years of experimental results at the Expanded Wheat Pasture Research program at Marshall, OK. A one percent death loss is assumed.

Operating inputs and costs include a \$6.00 per head charge for supplemental hay. Hay is fed during receiving and snow cover days, and is valued at \$60.00/ton. Salt and mineral are fed at a rate of .15 lb/day, with an estimated cost of \$4.31/head. Freight and marketing charges are \$.35/cwt and \$1.72/cwt, respectively. Vet and medical expenses are \$8.00/head and include vaccinations, worming, implants, and eartags, as well as a prorated share of sick pen charges. Estimates for machinery and equipment charges (\$6.09/head) as well as labor requirements (1.27 hours/head) were taken from the OSU Enterprise Budgets (Walker et al., 1992). Labor is valued at \$5.00/hour. Interest expense is calculated at \$22.49/head using an annual percentage rate of 12 percent.

Total receipts vary based upon the number of days cattle are grazed. The base stocker budget is included as Table 5.2. Freight and marketing charges will vary each year based upon the selling weight of the calves. Selling weight is a function of days pastured which varies with each strategy.

The stocker budget is calculated on a per-head basis. In order to determine total net return, the per-head return from the stocker enterprise is divided by the assumed stocking density of 2 acres/head and added to the per-acre wheat return.

Results

Calendar date removal strategies were developed to represent the range of alternatives available to producers in the study area. Figure 5.1 shows an approximation of the distribution of simulated jointing dates over the 40-year period. Jointing dates range from February 24 to March 27, with an average date of March 11. The calendar dates chosen for evaluation in the study closely correspond to these dates. February 23 is the earliest removal date considered, and one week intervals are then employed through March 20. Net return distributions are calculated over the 40-year period for each of the six calendar date removal strategies.

Identification of jointing date and removal of cattle is not as simple and straightforward as it might appear. Producers who utilize jointing indicators to remove cattle, differ in their ability to predict jointing date. In addition, labor availability and other factors may impede response time in removing cattle from wheat pasture. To evaluate the value of different levels of ability to employ jointing date in guiding removal dates, four different levels of prediction ability were represented. The ability to

predict jointing date is represented using a normal distribution with a mean of zero. Different levels of prediction ability are represented by incrementing the standard deviation of the distribution. Four levels of precision are considered and represented with distributions having standard deviations of 1, 2, 3 and 4. These activities are termed JNT \pm 1, JNT \pm 2, JNT \pm 3, and JNT \pm 4, respectively. Random variables generated from the distributions are added to or subtracted from actual jointing date to determine grazing termination date, and net return distributions are estimated for each degree of prediction ability.

Comparison of Net Return Distributions

The mean, standard deviation, range and skewness of the eleven net return distributions associated with various removal dates are included in Table 5.3. As one would expect, the perfect information forecast offers the highest average net return of \$51.23 per acre, with returns ranging from -\$2.88 to \$122.54 per acre. Moving from JNT \pm 1 to JNT \pm 4 causes the net return levels to decrease, that is, average net returns decrease as the level of prediction ability decreases. However, all of the prediction interval activities generate higher expected net return levels than any of the calendar date removal dates.

Of the calendar dates evaluated, a March 5 removal date provides the highest average net returns. Utilizing a February 23 removal dates causes livestock returns to be

diminished, therefore, causing overall net returns to be decreased. Net return levels increase from February 23 to March 5. Net returns are decreased after the March 5 calendar date due to decreases in grain yields caused by grazing after plants have jointed. Removal of livestock on March 20 provides the lowest average net returns of \$31.55 per acre, and returns range from a low of -\$15.47 to a high of \$110.19 per acre.

Risk Efficient Sets

To determine the influence of risk preferences on grazing termination date, stochastic dominance procedures were first applied to the various calendar date removal date alternatives. Table 5.4 reports the results of first-degree, second-degree, and generalized stochastic dominance criteria being applied to the six calendar removal dates.

The first-degree efficiency set includes four of the six dates evaluated. FSD only eliminates the earliest (February 23) and latest (March 20) calendar dates from the set. Not only do these sets yield the lowest average returns, but they also contain the lowest net return levels produced during the forty year time period. These two dates are eliminated from the first-degree set to minimize the probability of incurring a large negative return.

Second-degree stochastic dominance is more discriminating and includes only two of the six strategies in the efficient set. Only March 5 and March 10 are included in the SSD

efficient set. SSD holds for all decision makers who prefer more to less and are risk averse. March 5 and March 10 generate the highest average net return levels, and also minimize the possibility of incurring a low or negative return. Although each removal date generate negative returns at some time during the forty years evaluated, March 5 and March 10 removal produces the smallest negative returns. Decision makers represented by the SSD criteria are risk-averse and are concerned with minimizing the negative returns.

Generalized stochastic dominance orders decision choices more discriminately than either FSD or SSD. Using the Pratt-Arrow risk aversion coefficients to distinguish risk preferences, GSD orders choices based upon each decision maker's specified intervals. The specific intervals used in this analysis are included in Table 5.5. Four risk intervals are used to represent risk-preferring, risk-neutral, slightly risk-averse, and strongly risk-averse decision makers, and are based upon the empirical work of Cochran et al (1985). Intervals were scaled using techniques set forth by Raskin and Cochran (1986) so that an accurate representation of each decision maker's preferences are depicted.

The efficient set for risk preferring decision makers is limited to the March 15 activity. These producers are concerned with attaining the largest net return level possible and are not greatly concerned with the possibility of incurring negative returns. Therefore, risk preferrers have

a tendency to graze as long as possible, accepting the chance that grain yields might be reduced.

Under the assumptions of risk neutrality, the efficient set includes four removal dates: February 28, March 5, March 10, and March 15. These are the same four dates that comprise the FSD efficiency set.

Both slightly and strongly risk averse decision makers have only March 5 in their efficient set. Risk averse decision makers want to minimize the possibility of low or negative returns and, if necessary, will sacrifice the possibility of high net returns. By utilizing a March 5 removal date, the risk of decreased grain yield is low, but it is still possible to capture the majority of available grazing days. Essentially, these producers are attempting to minimize the probability of any significant loss in grain yield, while utilizing enough grazing days to assure adequate livestock revenue.

Value of Information

Table 5.6 reports the upper and lower bounds on the value of perfect jointing date information using generalized stochastic dominance and four sets of boundaries on the risk preference function. Boundaries on the risk preference function are identical to those used in the GSD analysis to derive the risk efficient removal dates for decision makers categorized as risk preferring, risk neutral, slightly risk averse, and strongly risk averse. Because the exact values

for $r_1(x)$ and $r_2(x)$ are not known, comparison of these estimates of information value provides a form of sensitivity analysis. In addition, changing the values of $r_1(x)$ and $r_2(x)$ allows one to evaluate the relationship between risk preferences and the value of jointing date information.

The value of jointing date information is shown to be sensitive to both risk preferences and the level of prior knowledge assumed. The level of prior knowledge reflects the calendar date strategy that the dominant (perfect information) strategy is being compared with. For example, if prior knowledge dictates the use of an early grazing termination date, the jointing date information takes on an extremely high value for the risk preferrer. The risk preferrer is interested in the possibility of high net return outcomes, even at the expense of increasing the probability of low outcomes. As discussed earlier, high annual net returns are possible when a late jointing date allows for extended grazing. The use of an early termination date reduces the probability of obtaining high annual net returns. Therefore, the risk preferrer will be willing to pay a large premium for the jointing date information and the possibility of realizing large net return outcomes. The risk preferrer will be less willing to pay for the information if prior knowledge dictates the use of a later termination date (e.g. March 15), since the possibility of attaining high annual net returns exists under the calendar date strategy. For the strongly risk averse producer, the reverse circumstance occurs. The jointing date

information has a much higher value to this individual if prior knowledge dictates the use of a later termination date.

Information is often characterized as a risk-reducing input. Such a case is illustrated when comparing the value of perfect information versus a March 15 calendar date strategy. The value of jointing date information to a risk preferrer ranges between \$1.03 and \$3.14 per acre, while the strongly averse decision maker is willing to pay between \$8.39 and \$9.12 per acre for the perfect information. A strategy of terminating grazing on a later calendar date (e.g. March 15) will result in decreased grain yields and low annual net returns in years of early jointing. The decision maker has a high willingness to pay for avoiding these situations due to his/her strong aversion to risk.

However, as the decision maker becomes more risk averse, he/she will not always be willing to pay more for information. Such a case can be illustrated by comparing the value of information across the four risk preferences when March 5 is the prior knowledge activity. The value of jointing date information decreases as the level risk aversion increases. In this case, jointing date information provides the producer the opportunity to increase expected net returns primarily by realizing some high net return outcomes. The March 5 calendar date is the preferred calendar date for the risk averter; therefore, he/she is less willing to pay for the information necessary to implement a flexible grazing termination date.

One can make a convincing argument that the value of

information across preferences should not be based upon a single calendar date. Producers employing calendar date strategies have some prior knowledge that allows them to select a termination date consistent with their risk preferences. This calendar date was identified in Table 5.4. If it is assumed that these strategies reflect decision makers' prior knowledge, a single value of information range can be identified at each preference interval. The risk efficient calendar date strategy is denoted with an asterisk in Table 5.6. Therefore, bounds on the value of perfect jointing date information are \$1.03 to \$3.14 per acre for the risk preferrer, \$3.14 to \$23.13 per acre for the risk neutral producer, \$3.69 to \$5.86 for the slightly risk averse producer, and \$2.79 to \$3.69 for the strongly risk averse producer. As proven by Hilton (1981), and illustrated here, information values do not necessarily behave in a monotonic fashion. However, the results do not indicate a greater willingness to pay for jointing date information on the part of risk averters than risk preferrers.

Table 5.7 provides estimates of the value of perfect jointing date information when compared to the four distributions representing different levels of reliability of jointing date projections. Comparison of these distributions provides an indication of the value of incremental improvements in a producer's ability to identify jointing date. The value of perfect jointing date information decreases as decision makers become more risk averse. For

example, when comparing the perfect information distribution with the JNT±3 distribution, the value of information decreases from \$1.73 to \$2.84 for the risk preferrer to \$1.04 to \$1.18 for the strong risk averter.

Sensitivity Analysis

Another important question is "Does the value of information change significantly under alternative price structures?" The results reported above represent the average commodity price situation over the past ten years. To determine the effect of alternative economic conditions, wheat and stocker cattle prices were adjusted to create two different price structures. A situation where wheat price is high and cattle prices are low is evaluated, as is a situation where wheat price is low and cattle prices are high.

To create the alternative price structures, the ten year average selling prices of both wheat and stocker cattle were calculated in real terms (1992 dollars). These prices were then sorted into the three highest, three lowest and the remaining four were considered the median price situation. The average of the low and high prices are used to create the two alternative price structures. Wheat prices used are \$2.50, and \$3.50/bushel for the low and high price situations, respectively. Steer selling prices reflect a value of gain of \$44.00/cwt for the low cattle price scenarios and \$72.00/cwt for the high cattle price scenario.

The upper and lower bounds in Table 5.8 reflect the value

of information under two alternative price scenarios. The value of perfect jointing date information is reported for risk intervals representing risk preferring and strongly risk averse decision makers. The impact of economic conditions on information value is also dependent upon the risk preferences. Under the "high cattle-low wheat" scenario, the value of information to the risk preferrer increases relative to the baseline. Net return is most sensitive to cattle prices; therefore, very high net return outcomes are possible under this scenario. Risk preferrers are willing to pay more for jointing date information to improve their probability of realizing these high net returns. On the other hand, the value of information for the risk averse decision maker decreases relative to the baseline.

Under the "low cattle-high wheat" scenario, the value of jointing date information increases as the level of risk aversion increases. In this situation, incorrect termination dates can result in grain yield reductions that translate to low annual net returns. Risk averters trying to avoid these low net return outcomes will be more willing to pay for jointing date information than risk preferrers.

Summary and Conclusions

Producers who utilize winter wheat forage to graze cattle must be cognizant of jointing date to reduce the probability of decreasing grain yields. It is likely that some producers have caused yield reductions, and subsequently have reduced

wheat revenue, by grazing too long. This study has shown that decision makers, regardless of risk preference, do place value on accurate jointing date information.

Results show that the value of information will vary across risk preferences of individuals, and across different price structure of wheat and cattle prices. Decision makers prior knowledge also interacts with preferences and prices in determining the lower and upper bounds on the value of perfect jointing date forecasts.

TABLE 5.1
WHEAT PRODUCTION BUDGET

OPERATING INPUTS:	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.30	1.33	5.72
Nitrogen (AA)	lb	0.09	122	10.98
18-46-0 Fert.	lb	0.10	50	5.00
Topdressing	lb	0.20	20	4.00
Herbicide(Glean)	appl	5.75	1	5.75
Insecticide	appl	3.60	1	3.60
Custom Harvest	acre	14.04	1	14.04
Custom Hauling	bu	0.12	**	0.00
Mach.& Equip. Co	acre	17.97	1	17.97
Interest Expense	acre	0.13	43.72	5.68
Labor	acre	5.50	0.96	5.28
Total Operating Costs				78.02

**Based upon grain yield.

TABLE 5.2
STOCKER PRODUCTION BUDGET

OPERATING INPUTS:	UNIT	PRICE	QUANTITY	VALUE
Stocker Calves	cwt	104.22	4.50	468.99
Supplemental Hay	lb	0.03	200	6.00
Salt & Mineral	lb	0.15	28.75	4.31
Freight	cwt	0.35	*	0.00
Marketing	cwt	1.72	*	0.00
Vet-Med Expenses	hd	8.00	1	8.00
Mach. & Equip. Co	hd	6.09	1	6.09
Interest Expense	dol	0.12	187.40	22.49
Labor	hr	5.00	1.27	6.35
Total Operating Costs				522.23

*Based upon selling weight of cattle.

TABLE 5.3
SUMMARY OF PER-ACRE NET RETURNS FROM
ALTERNATIVE REMOVAL DATES

REMOVAL DATE	MEAN	STD. DEV	HIGH	LOW	SKEWNESS
PERFECT	\$51.23	\$38.08	\$122.54	(\$2.88)	0.33
JNT±1	\$50.31	\$38.02	\$121.68	(\$3.39)	0.35
JNT±2	\$49.15	\$37.60	\$120.83	(\$3.39)	0.37
JNT±3	\$48.32	\$37.53	\$120.83	(\$3.90)	0.39
JNT±4	\$47.16	\$37.38	\$119.97	(\$3.90)	0.43
FEB23	\$37.12	\$37.03	\$102.88	(\$13.48)	0.30
FEB28	\$40.90	\$37.18	\$107.14	(\$9.21)	0.33
MARCH5	\$42.43	\$36.71	\$112.28	(\$5.44)	0.39
MARCH10	\$41.48	\$36.22	\$116.55	(\$7.99)	0.51
MARCH15	\$38.41	\$37.55	\$120.83	(\$10.62)	0.74
MARCH20	\$31.55	\$36.29	\$110.19	(\$15.47)	0.84

TABLE 5.4

RISK EFFICIENT SETS FROM FIRST, SECOND AND
GENERALIZED STOCHASTIC DOMINANCE

FSD: FEB28, MARCH5, MARCH10, MARCH15

SSD: MARCH5, MARCH10

GSD:

RISK PREFERRING	MARCH15
RISK NEUTRAL	FEB28, MARCH5, MARCH10, MARCH15
SLIGHTLY RISK AVERSE	MARCH5
STRONGLY RISK AVERSE	MARCH5

TABLE 5.5
PRATT/ARROW RISK AVERSION COEFFICIENTS

	Upper	Lower
Risk Preferring	-0.0008	-0.0001
Risk Neutral	-0.0001	0.0001
Slightly Risk Averse	0.0001	0.0004
Strongly Risk Averse	0.0004	0.001

TABLE 5.6

LOWER AND UPPER BOUNDS ON THE VALUE OF PERFECT INFORMATION
VERSUS CALENDAR DATE REMOVAL STRATEGIES FOR DIFFERENT
RISK PREFERENCE INTERVALS (\$/ACRE)

	LOWER -----	UPPER -----
RISK PREFERRING:		
FEB23	\$16.93	\$19.51
FEB28	\$12.65	\$15.23
MARCH5	\$9.20	\$10.19
MARCH10	\$5.31	\$7.19
MARCH15*	\$1.03	\$3.14
MARCH20	\$10.44	\$12.22
RISK NEUTRAL:		
FEB23	\$12.30	\$17.12
FEB28*	\$8.26	\$12.86
MARCH5*	\$5.86	\$11.91
MARCH10*	\$6.22	\$17.50
MARCH15*	\$3.14	\$23.13
MARCH20	\$11.97	\$30.32
SLIGHTLY RISK AVERSE:		
FEB23	\$11.15	\$12.31
FEB28	\$6.88	\$8.26
MARCH5*	\$3.69	\$5.86
MARCH10	\$5.60	\$6.34
MARCH15	\$8.80	\$9.68
MARCH20	\$12.97	\$13.95
STRONGLY RISK AVERSE:		
FEB23	\$10.74	\$11.16
FEB28	\$6.46	\$6.89
MARCH5*	\$2.79	\$3.69
MARCH10	\$5.19	\$5.62
MARCH15	\$8.39	\$9.12
MARCH20	\$12.67	\$13.24

TABLE 5.7

LOWER AND UPPER BOUNDS ON THE VALUE OF PERFECT INFORMATION
 VERSUS VARYING DEGREES OF JOINTING DATE PREDICTION
 ABILITY FOR DIFFERENT RISK PREFERENCE
 INTERVALS (\$/ACRE)

	LOWER	UPPER
	-----	-----
RISK PREFERRING:		
JNT±1	\$0.79	\$1.04
JNT±2	\$1.71	\$2.19
JNT±3	\$1.73	\$2.84
JNT±4	\$2.58	\$3.57
RISK NEUTRAL:		
JNT±1	\$0.53	\$1.45
JNT±2	\$1.09	\$3.14
JNT±3	\$1.58	\$4.54
JNT±4	\$2.05	\$6.54
SLIGHTLY RISK AVERSE:		
JNT±1	\$0.53	\$0.67
JNT±2	\$0.66	\$1.09
JNT±3	\$1.19	\$1.58
JNT±4	\$1.39	\$2.05
STRONGLY RISK AVERSE:		
JNT±1	\$0.46	\$0.53
JNT±2	\$0.52	\$0.66
JNT±3	\$1.04	\$1.18
JNT±4	\$1.09	\$1.39

TABLE 5.8

LOWER AND UPPER BOUNDS ON THE VALUE OF PERFECT INFORMATION
UNDER ALTERNATIVE PRICE SCENARIOS FOR DIFFERENT
RISK PREFERENCE INTERVALS (\$/ACRE)

	HIGH CATTLE-LOW WHEAT		LOW CATTLE-HIGH WHEAT	
	LOWER	UPPER	LOWER	UPPER
	-----	-----	-----	-----
RISK PREFERRING:				
FEB23	\$18.28	\$20.66	\$15.78	\$18.56
FEB28	\$13.74	\$16.12	\$11.72	\$14.50
MARCH5	\$10.06	\$10.80	\$8.60	\$9.69
MARCH10	\$5.63	\$7.57	\$5.05	\$6.87
MARCH15	\$1.09	\$3.39	\$0.99	\$2.94
MARCH20	\$7.94	\$9.58	\$13.00	\$14.93
STRONGLY RISK AVERSE:				
FEB23	\$10.18	\$10.90	\$11.30	\$11.49
FEB28	\$5.64	\$6.37	\$7.24	\$7.43
MARCH5	\$1.44	\$2.64	\$4.10	\$4.61
MARCH10	\$2.36	\$3.09	\$7.83	\$8.00
MARCH15	\$4.06	\$4.98	\$12.56	\$13.02
MARCH20	\$6.54	\$7.38	\$18.63	\$18.81

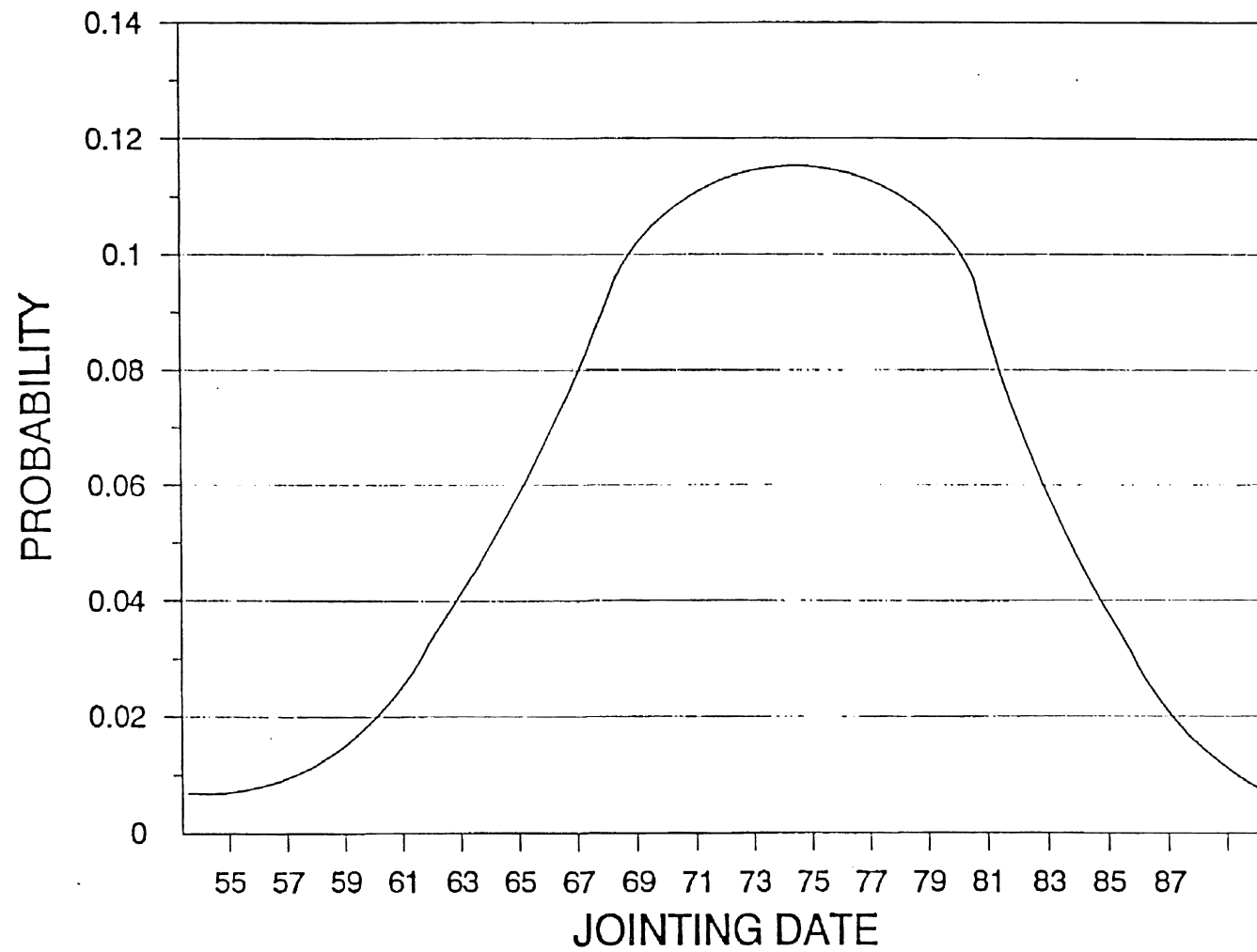


Figure 5.1. Distribution of Jointing Dates

CHAPTER VI

CONCLUSIONS, IMPLICATIONS AND THE NEED FOR FURTHER RESEARCH

The purpose of this thesis was to provide additional economic analysis in the area of wheat pasture grazing and management. The lack of research in this area has caused many current managerial practices to be based on tradition and habit, and the introduction of new technology has been very limited. The attempt to validate the economic efficiency of several current practices should provide producers with important information, and hopefully, help guide their decision processes. The introduction of new managerial practices and decision aids will allow producers more flexibility and increase the number of options available to them.

Because research in the area of wheat pasture grazing and management has been limited, studies conducted through the Expanded Wheat Pasture Research Program have provided valuable research information. This thesis has focused on the economic analysis of the first three years of experimental data from this program. Research is ongoing and significant research data will continue to be produced. Several topics which are currently perceived as important to the industry have been addressed in this study.

The development of a microcomputer model which incorporates wheat government program planning considerations is the first item addressed in this study. This model provides a useful tool for conducting much of the multiple-enterprise analysis required in this study. In addition, the decision aid is potentially a valuable planning and decision tool for producers. The incorporation of supplemental feeding programs is evaluated on both an enterprise and a whole-farm level to determine the profitability of the practice. Next, the question of wheat variety selection for the joint production of grain and stocker cattle grazing is addressed. Twelve wheat varieties are economically evaluated based upon their grain and forage production. Finally, a value of information study is conducted to determine the value of perfect jointing information to producers in making grazing termination date decisions.

Wheat/Stocker Planner

Planning and capital budgeting are important components of successful farm and ranch management. The complexities introduced by the joint production of wheat and stocker cattle introduce several challenges to farm managers in developing whole-farm plans. In addition, most producers who utilize winter wheat forage to graze livestock currently participate in some type of government wheat program. Government program payments are an important component of their farm income. The importance of these joint product and government program

considerations is demonstrated with the development and use of the Wheat/Stocker Planner.

The Wheat/Stocker Planner is a microcomputer decision aid which allows for planning and evaluation of alternative grazing and management practices. The Planner provides the means in which to incorporate all components of a grazing system into overall farm planning and management. User-provided inputs are needed to develop enterprise budgets for fall/winter and graze out stockers, as well as winter wheat. The whole-farm and government program section allows for enterprise analysis to be taken to the farm level, where farm-level net returns under the "Regular" and "0/92" program options, as well as a non-participation option, is determined. The sensitivity analysis section allows the user to determine the effects of price and production changes on overall profitability.

Because program provisions change from year to year, the Wheat/Stocker Planner can be updated with current provisions which will allow producers to stay abreast of the ever-changing rules and requirements, and use these provisions to their advantage. The use of the Wheat/Stocker Planner should improve planning and decision making and allow for the identification and implementation of plans consistent with producer's economic objectives.

Supplementation

Research results have shown that supplemental feeding programs can positively influence livestock production. However, the important economic aspects of these programs have not yet been determined. Although there are many advantages to supplemental feeding, the programs must improve the profitability of grazing, as well as improve livestock performance. The economic significance of supplemental feeding was evaluated on a per-head and whole-farm basis.

Three years of experimental data show that supplemental feeding programs can increase average daily gain of stockers grazing wheat pasture. Use of a high-fiber supplement increased daily gains an average of .29 pounds per day over a three-year period. Stocking density can also be increased. Benefits such as decreased death loss from bloat, delivery of new technologies, and increased flexibility add to the value of the program, but are difficult to quantify.

The enterprise analysis determined that per-head and per-acre returns are generally decreased by employing the supplemental feeding programs. However, this analysis ignores a principal benefit of supplementation, in that stocking density can be increased and more cattle can be grazed. The whole-farm analysis demonstrates the effect of the increased stocking density in conjunction with wheat program provisions. Net returns under supplementation are increased by 38.3%, 15.6%, and 50.2% for the "non-participation", "regular", and

"0/92" options, respectively, over non-supplemented cattle. The stocking density effect is obviously important to the profitability of the program. It was determined that a 54% increase in stocking density will offset the cost of the program, as would a decrease of 1.85% in death loss.

Although whole-farm returns are increased by using a supplemental feeding program, it is important to remember that both price and production risk are increased as a result of grazing more cattle. All aspects of the supplementation strategy are not yet understood and require more analysis to determine its affect under various economic and environmental situations. However, as long as producers understand the advantages and disadvantages of this system, supplementation appears to offer some very positive benefits to those producers who incorporate it into their management plans.

Variety Selection

Variety selection is obviously a key planning variable for decision makers. The introduction of new, better performing varieties tends to complicate the process. Performance data on new varieties requires several years of trials to gain an accurate understanding of its capabilities. However, performance data alone does not provide adequate information as to the potential profit varieties can produce from combined grain and grazing enterprises. There is a great need to combine grain and forage production into a simple ranking system. Evaluating and ranking wheat varieties on the

net return levels they produce, will provide a more accurate assessment of their usefulness in a grazing system.

Twelve wheat varieties were economically evaluated based upon both grain and forage production. Three forage allocation methods were used to estimate per-acre net returns from the combined grain and grazing income. Net return levels were estimated from nine evaluation sites over three years and ranked accordingly.

Results show that Karl, Thunderbird, and Pioneer 2180 consistently produce the highest net return levels under each forage allocation scheme. The importance of not only grain production, but also the timing and total production of forage growth is also revealed. Forage allocation methods and price structures affect net return levels but do not significantly affect relative economic rank.

Because the data used in this analysis is limited, and given the diversity of the growing environments, it is difficult to make any unequivocal recommendations. However, the economic analysis performed is more comprehensive and rigorous than methods currently used and does provide more insight into the relative profitability of these twelve varieties.

Wheat Jointing Date

Wheat jointing date is a significant decision point for producers who graze wheat and wish to harvest a grain crop. Producers utilize many different methods to determine when

cattle should be removed from wheat pasture. Because grazing past jointing can cause significant grain yield losses, the importance of forecast information has increased. Utilizing a fixed calendar date or observation removal strategy may not provide producers with the highest possible net return levels.

The value of wheat jointing date information was determined for producers with alternative risk preferences. Generalized stochastic dominance was used to determine the lower and upper bounds on the value of perfect jointing date forecasts. The analysis was performed for individuals displaying risk preferring, risk neutral, slightly risk averse, and strongly risk averse preferences. Alternative price structures, and varying levels of prior knowledge were also evaluated.

Basing grazing termination date on jointing increases average net returns from \$8.80 to \$19.68 per acre above the calendar date strategies evaluated. It was determined that the value of jointing date information varies across risk preferences of individuals and price structures. In addition, information value does not always behave in a monotonic fashion, and risk averters do not necessarily have a higher willingness to pay for jointing date information than do risk preferrers. Decision makers prior knowledge also affects the bounds on the information. Nonetheless, the ability to predict jointing date and utilize this information in determining grazing termination date has significant value for all producers, despite their risk attitudes.

Future Research Needs

Given the economic importance of wheat pasture grazing to Oklahoma and other Southern Plains states, the support of further research should be more than justified. Beef cattle and wheat are the two most important enterprises in Oklahoma; research which helps increase returns and decrease risk will benefit both state and regional economies.

Research conducted in this study should be viewed as merely a starting point for future research efforts focusing on the economics of wheat pasture grazing. Obviously, the joint production of wheat and stocker cattle is an extremely complex system and will require considerable additional study. The success of future economic research efforts will depend critically on developing a better understanding of the physical relationships underlying the production system. The Expanded Wheat Pasture Research Project and subsequent studies should provide much needed experimental data to better quantify the important interactions characterizing the production system. A systems model, integrating the current level of understanding of agronomic, livestock, and economic components of the production system is one of the primary goals of this research effort. The Wheat Grazing Systems Model developed by Rodriguez et al. (1989) is a first step in this direction. Future modification and validation of this model should prove invaluable in making significant contributions to improving the economic efficiency of wheat

pasture grazing.

The Wheat/Stocker Planner is the first step in developing a decision aid to assist producers with decision making and planning. The program can be updated to keep producers abreast of the changing government program provisions. Future work will focus on integrating the Planner into an interactive knowledge-based system. This system will combine this economic component with the physical components of the Wheat Grazing System to produce an integrated systems model for analysis of wheat-stocker production decisions.

Several more years of data are needed in order to fully evaluate supplemental feeding programs. As mentioned earlier, not all of the important aspect of these programs are fully understood, and more refinement is needed. Methods which can quantify the gains from the use of ionophores, poloxalene, and other technologies, which increase gains and decrease death loss, need to be used to evaluate these programs. While supplementation programs currently offer some very positive aspects, more detailed analysis is necessary.

Variety selection is a topic which will always be important to producers. The introduction of new varieties represents an important and evolving technology available to producers. Procedures are needed to provide timely information concerning the potential economic effects of adopting new varieties. The method used to evaluate these twelve varieties is more comprehensive than methods previously used; however, additional data is needed on how varieties

perform under different environmental conditions. Also, more detailed production data is required than is currently available. In order to attain a more accurate picture of the profit capability of each variety, additional grain yield and clipping data is needed. The number and frequency of clipping trials performed must be increased to accurately depict each varieties total forage growth potential and determine if timing of growth is consistent with the needs of grazing livestock.

The value of information study shows that possessing the ability to accurately predict jointing in grazing wheat plants can allow producers to maximize net returns. Again, further research is needed to validate the relationship between grazing termination date and grain yield reduction. While identifying jointing is only one component of grazing management, successful management depends on coordination of all minor parts into a successful whole. Producers who are able to make all the minor components work to their advantages maintain the highest net returns.

Many different projects could have been undertaken to complete this thesis. Important topics that were not addressed include the economic significance of such management variables as stocking density, wheat cultural practices, fertilization, and stocker purchases (sex, weight, and breed). This analysis has centered on items that are currently perceived as important and useful to producers, and for which empirical data is available. Hopefully, the information

presented is useful and will benefit producers and future research efforts.

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APPENDIX

OPERATING COST INFORMATION FOR
EACH LOCATION

OPERATING COST INFORMATION FOR EACH LOCATION

BUFFALO 1989-90	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
Anhydrous Ammonia	lbs	0.11	82.00	9.02
Alley Herbicide	oz	29.10	0.10	2.91
Rent Anhydrous	acre	0.25	1.00	0.25
Custom Chemical App.	acre	2.25	1.00	2.25
Annual Operating Capital	dol	0.12	24.59	2.95
Labor Charges	hr	4.50	3.50	15.77
Machinery Fuel, Lube, Repair	acre		25.25	25.25
TOTAL OPERATING COSTS				65.15

FURCELL 1989-90	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
(18-46-0) Fertilizer	lb	11.00	1.00	11.00
Nitrogen Fertilizer	lb	0.16	45.00	7.20
Disyston Insect.	oz	2.91	5.00	14.55
Rent Anhydrous	acre	0.25	1.00	0.25
Anhydrous Ammonia	lb	0.11	80.00	8.80
Rent Fert. Spread.	acre	2.25	1.00	2.25
Finesse Herbicide	oz	19.50	0.50	9.75
Annual Operating Capital	dol	0.12	55.00	6.60
Labor Charges	hr	4.50	4.02	18.10
Machinery Fuel, Lube, Repair	acre		33.00	33.00
TOTAL OPERATING COSTS				118.25

MARSHALL 1989-90	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
(18-46-0) Fertilizer	cwt	11.00	1.00	11.00
Fertilizer Application	acre	3.42	1.00	3.42
Anhydrous Ammonia	lbs	0.11	120.00	13.20
Rent Anhydrous	acre	0.50	1.00	0.50
Glean Herbicide	oz	10.08	0.25	2.52
RhonoX Herbicide	oz	1.91	0.50	0.96
Annual Operating Capital	dol	0.12	37.80	4.54
Labor Charges	hr	4.50	3.08	13.88
Machinery Fuel, Lube, Repair	acre		21.48	21.48
TOTAL OPERATING COSTS				78.24

CHICKASHA 1990-91	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
Nitrogen Fertilizer	cwt	11.00	2.43	26.73
Fertilizer Application	acre	2.25	1.00	2.25
Anhydrous Ammonia	lbs	0.11	60.00	6.60
Rent Anhydrous	acre	0.25	2.00	0.50
Glean Herbicide	oz	10.08	0.25	2.52
RhonoX Herbicide	oz	1.91	0.50	0.96
Annual Operating Capital	dol	0.12	37.80	4.54
Labor Charges	hr	4.50	3.08	13.88
Machinery Fuel, Lube, Repair	acre		21.48	21.48
TOTAL OPERATING COSTS				86.20

FREDRICK 1990-91	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
Nitrogen Fertilizer	cwt	16.00	1.74	27.88
Fertilizer Application	acre	2.25	1.00	2.25
Anhydrous Ammonia	lbs	0.11	60.00	6.60
Rent Anhydrous	acre	0.25	2.00	0.50
K20 Fertilizer	lbs	0.20	40.00	8.00
Glean Herbicide	oz	10.08	0.25	2.52
RhonoX Herbicide	oz	1.91	0.50	0.96
Annual Operating Capital	dol	0.12	37.80	4.54
Labor Charges	hr	4.50	3.08	13.88
Machinery Fuel, Lube, Repair	acre		21.48	21.48
TOTAL OPERATING COSTS				95.35

MARSHALL 1990-91	UNIT	PRICE	QUANTITY	VALUE
Wheat Seed	bu	4.50	1.50	6.75
(18-46-0) Fertilizer	cwt	11.00	1.00	11.00
Fertilizer Application	acre	3.42	1.00	3.42
Anhydrous Ammonia	lbs	0.11	120.00	13.20
Rent Anhydrous	acre	0.50	1.00	0.50
Glean Herbicide	oz	10.08	0.25	2.52
RhonoX Herbicide	oz	1.91	0.50	0.96
Annual Operating Capital	dol	0.12	37.80	4.54
Labor Charges	hr	4.50	3.08	13.88
Machinery Fuel, Lube, Repair	acre		21.48	21.48
TOTAL OPERATING COSTS				78.24

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FREDRICK 1991-92      UNIT      PRICE  QUANTITY  VALUE
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Wheat Seed           bu          4.50      1.50     6.75
Nitrogen Fertilizer  cwt         16.00      1.00    16.00
10-34-0 Fertilizer   acre         0.06    115.00     6.33
Annual Operating Capital  dol         0.12     37.80     4.54
Labor Charges        hr          4.50      3.08    13.88
Machinery Fuel,      acre         21.22     21.22    21.22
  Lube, Repair
TOTAL OPERATING COSTS                                68.71
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HASKELL 1991-92      UNIT      PRICE  QUANTITY  VALUE
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Wheat Seed           bu          4.50      1.50     6.75
Nitrogen Fertilizer  cwt         16.00      1.00    16.00
10-34-0 Fertilizer   lbs          0.06    115.00     6.33
60-46-60 Fertilizer  cwt         16.20      1.00    16.20
Glean Herbicide      oz          10.08      0.33     3.33
Custom Aerial Appl.  acre         1.70      1.00     1.70
Annual Operating Capital  dol         0.12     37.80     4.54
Labor Charges        hr          4.50      3.08    13.88
Machinery Fuel,      acre         20.08     20.08    20.08
  Lube, Repair
TOTAL OPERATING COSTS                                88.80
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MARSHALL 1991-92     UNIT      PRICE  QUANTITY  VALUE
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Wheat Seed           bu          4.50      1.50     6.75
(18-46-0) Fertilizer cwt         11.00      0.75     8.25
Fertilizer Application  acre         0.63      1.00     0.63
Anhydrous Ammonia     lbs          0.11    60.00     6.60
Rent Anhydrous        acre         0.50      1.00     0.50
Glean Herbicide      oz          10.08      0.17     1.71
Lime                  acre         1.91      0.50     0.96
Annual Operating Capital  dol         0.12     37.80     4.54
Labor Charges        hr          4.50      3.08    13.88
Machinery Fuel,      acre         22.39     22.39    22.39
  Lube, Repair
TOTAL OPERATING COSTS                                66.20
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VITA

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